OVERVIEW OF THE YUKON RIVER SALMON FISHERY 2001-2003

A REPORT TO THE ALASKA BOARD OF FISHERIES

By

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and

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INTRODUCTION

The Yukon-Northem Area includes all waters of Alaska between the latitude of Point Romanof and the latitude of the westemmost point of the Naskonat Peninsula, including those waters draining into the Bering Sea, and all waters of Alaska north of the latitudc of the westemmost tip of Point Hope and west of 141° W. longitude, including those waters draining into the Arctic Ocean and the Chukchi Sea. The Yukon River is the largest river in Alaska and the fifth largest drainage in North America. The river originates in British Columbia, Canada, within 30 miles of the Gulf of Alaska, and flows over 2,300 miles to its mouths at the Bering Sea. It drains an area of approximately 330,000 square miles and approximately 35% of Alaska. With the possible exception of a few fish taken near the mouth or in the adjacent coastal waters, only salmon of Yukon River origin are harvested in the Yukon Area.

The Yukon River is divided into 6 districts for management purposes. Districts 1, 2, and 3 describe the Lower Yukon Area. Districts 4, 5, and 6 describe the Upper Yukon Area (Figure 1). There is also a Coastal District, which encompasses all waters between the latitude of the westemmost point of the Naskonat Peninsula and the latitude of Point Romanof. Descriptions of the area can be found in 5 AAC 05.200. Fishing districts and subdistricts. Because the districts in thc upper area are so large, these districts are further broken into subdistricts. District 4 has 3 subdistricts, Subdistricts 4-A, B, and C. District 5 has 4 subdistricts, Subdistricts 5-A, B, C, and D, and District 6 has 3 subdistricts, Subdistricts 6-A, B, and C.

Excluding the greater Fairbanks area (approximately 84,000 residents), there are approximately 21,000 rural residents in the Alaskan portion of the drainage, the majority of whom reside in 43 small villages scattered along the coast and major river systems. Most of these people are dependent to varying degrees on fish and game resources for their livelihood.

During the fishing season, management is based on preseason projections and inseason run assessment. Inseason run assessment includes abundance indices from test fisheries, passage estimates from various sonar, mark-recapture projects, and spawning escapements and harvest data. Since 1995, the main river sonar project at Pilot Station has provided inseason estimates of salmon passage for fisheries management (Pilot Station did not operate in 1996). The level of subsistence, personal use, and commercial harvests can be adjusted through the use of emergency orders to control time and area openings and closures.

STOCK STATUS

Yukon River chinook salmon escapements have generally been met since 1999. A small unharvested surplus existed in 2001 when no commercial fishing occurred and larger unharvested surpluses in 2002 and 2003 were the result of conservative management actions. The yield from this stock during four of the last five years was well below the long-term average. Because of the reduced yield in recent years, chinook salmon are considered a yield concern.

Summer chum salmon escapement goals were not met during the past five years, except for the Anvik River in 1999 and 2002, even though management actions were taken to provide for

escapement. Subsistence and commercial harvests from 1999 through 2003 were below recent averages. Because escapement goals have not been consistently met in recent years, the summer chum salmon is classified as a management concem.

Several indiv dual fall chum salmon escapement goals were not met during the past five years even though extreme management actions were taken. However, the drainage-wide optimal escapement goal of 350,000 fall chum salmon was met in two of the previous five years (2002 and 2003). Elased on subsistence and commercial harvests being substantially below the previous average yield, the department recommends continued classification of fall chum salmon as a y eld concern.

The department recommends using the biological escapement goal of 15,000 to 33,000, developed in 2000, to assess the Toklat River escapement during recent years rather than the optimum escapement goal of 33,000 fall chum salmon. The biological escapement goal was met in 1998,2002, and 2003. The Toklat River would be reclassified from the designation as a management concern to a yield concern under the remainder of the fall chum salmon stock.

The department recommends removing the Fishing Branch River, which is entirely in Canada, as a stock of rnanagement concem. The U.S./Canada Joint Technical Committee and the Yukon River Panel address management of this stock annually. It will continue to be addressed under the fall chum salmon yield concern and be managed conservatively under the Yukon River drainage fall (hum salmon management plan.

HARVEST TRENDS

Chinook Salmon

Combined cornrnercial and subsistence harvests show a substantial decrease in chinook salmon yield from th: 10-year period of 1989 to 1998 compared to the recent 5-year (1999-2003) average (Tables 1 and 2). The 1989 to 1998 average harvest of approximately 156,000 fish is twice the recent 5-year average harvest of approximately 77,000 fish. Although the subsistence harvest continues to remain relatively stable, commercial harvests have been reduced considerably to meet escapement and subsistence needs. The 2000 chinook salmon run was the poorest on record with a subsistence harvest of about 36,000 fish and a commercial harvest of approximately 9,000 fish. In response to the extremely poor run in 2000, conservative management strategies were employed. In 2001, no commercial or sport fishing occurred and management actions were taken to reduce subsistence fishing time below the regulatory schedule adopted by the Board in January 2001. However, it was determined postseason there was a surplus of approximately 20,000 chinook salmon beyond escapement and subsistence needs. The 2002 chinook salmon run was similar in run strength to the 2001 run and 24,000 fish were commercially harvested. The 2003 chinook salmon run was much stronger than anticipated. The preseason outlook was for a small commercial harvest of 0-20,000 chinook salmon. Because of the surprising strength of the run, the commercial harvest reached 41,000 fish, the largest commercial harvest since 1999. Possible foregone harvest is difficult to determine, but based on the assessed near record escapements into the Tanana River and Canada, cornrnercial fishers may have foregone up to an additional 40,000 chinook salmon.

The 2003 subsistence salmon harvest survey information is not complete at this time, but the chinook salmon harvest is expected to be greater than average. Many subsistence fishermen indicated they had harvested additional chinook salmon to compensate for the anticipated poor returns of both summer and fall chum salmon.

Summer Chum Salmon

Combined commercial and subsistence harvests show a substantial decrease in yield from the 10-year period of 1989 to 1998 compared to the recent 5-year (1999-2003) average (Tables 1 and 3). The 1989 to 1998 average harvest of approximately 656,000 fish is more than seven times the recent 5-year average harvest of approximately 90,000 fish. Most of this difference in harvest is because of poor runs since 1998. Although subsistence harvest:; have declined approximately 35%, commercial harvests have been reduced by 97% to meet escapement and subsistence needs. In the past, chum salmon harvested for roe sales fulfilled two functions because the fishers would also utilize the unsold carcasses for subsistence. Management of summer chum salmon has been very conservative in recent years, similar to chinook salmon. Commercial harvest of summer chum salmon has been incidental to chinook salmon directed fishing since 1998, except for a limited directed harvest in District 6, a termina' harvest area on the Tanana River, in 2002 and 2003.

Fall Chum Salmon

Combined commercial and subsistence harvests show a substantial decrease in yield from the 10-year period of 1989 to 1998 compared to the recent 5-year period of 1999 to 2003 (Tables 1 and 4). The 1989 to 1998 average harvest of approximately 255,000 fish is five times the recent 5-year average harvest of approximately 51,000 fish. Commercial harvest has been practically nonexistent since 1998 and subsistence harvest has been reduced considerably to meet escapement needs. Historically, chum salmon harvested for roe sales have fulfilled two functions because the fishermen would also utilize the unsold carcasses for subsistence. Most of this difference in harvest is because of poor runs since 1998, which has resulted in extremely conservative management. Because of the overlap of fall chum and coho salmon, commercial and subsistence harvest of coho salmon is influenced by fall chum salmon management actions. Tables 1 and 5 describe coho salmon harvest trends.

EFFORT

A total of 582 permit holders participated in the chinook and summer chum salmon commercial fishery during 2003, which was 18% below the 1993-2002 average of 712 permit holders (Table 6, Figure 2). The level of effort was nearly identical to the 2000 effort of 562 and 560 for 2002. Although commercial fishing opportunity for the summer season has been reduced in recent years, the higher prices that chinook salmon command and the need for cash to support subsistence fishing activities has maintained a high commercial fisherman participation.

Because of poor runs, the need to meet escapements and subsistence need:: has precluded commercial fishing for fall chum salmon from 2000-2002. There was a commercially harvestable surplus of coho salmon in some of these years, but because of the overlapping run

timing with fall chum salmon, it was not possible to take advantage of this surplus. However, in 2003, a surplus of both fall chum salmon and coho salmon allowed a commercial harvest to take place late in the season in both the lower and upper areas of the drainage. There were 75 commercial fishers in the Lower Yukon Area that participated and seven in the Upper Yukon Area for a total of 82 fishers (Table **6,** Figure **3).**

VALUE

The Yukon River commercial fishing seasons are divided between the summer and fall seasons. In the summer season, the value of the fishery is typically driven by the chinook salmon market for its high quality oily flesh. In the fall season, fall chum salmon flesh and roe fisheries typically drive the value. For both seasons, there was no commercial fishing in 2001. For fall chum salmon, 2003 was the first year commercial fishing was allowed since 1999. The fall season harvest in 2003 was primarily directed at coho salmon in both the lower and upper portions of the river because of the relative abundance late in the season, however, both species of salmon were harvested and sold together.

Excluding 1998 to 2002, years with poor runs, the historical value of the summer season has ranged from 91.9 million in 2003 to $11.8 million in 1988, with the 11 year average (1993-2003) of $4.5 million (Table 7, Figure 4). In 2003, management was very conservative and up to 40,000 commercially harvestable chinook salmon was foregone (up to $2.0 million). The 2002 summer season value was $1.7 million and $1.9 million in 2003. Although the 2003 chinook salmon harvest was nearly twice the 2002 harvest, the per pound value of chinook salmon in 2003 ($2.37/lb) was significantly less than the 2002 per pound value ($3.77/lb). Summer chum salmon harvest in recent years has essentially been incidental to the chinook salmon directed fishery with the exception of an occasional directed fishery in the Tanana River. The value of the fall chum and coho salmon directed fishery in 2003 was $33,000 (Figure 5). This value is 37% below the previous 10- year average of $88,000. The average price per pound of chum salmon was $0.13 and coho salmon was $0.21, which compares to the previous 10-year averages of $0.18 and $0.30 respectively.

Overall, the value of the Yukon River salmon fishery has declined substantially in recent years. Commercial fshing has been significantly restricted or reduced to provide for adequate escapements and ensure subsistence harvest opportunity. Future commercial markets of Yukon River salmon are in question. The inconsistent returns of salmon and the increasing cost of transportation has caused buyers to look elsewhere to supply their salmon markets for both fish flesh and roe. Prior to the poor runs of 1998, the number of buyers purchasing Yukon River chinook salmon was usually around 8-10 buyers. In 2003, that number decreased to four including three in the lower and one in the upper river. At this time, the number of buyers may decrease again in 2004 because profitability for Yukon River salmon continues to decline for all species.

SUBSISTENCE HARVESTS

The Yukon River subsistence salmon fishery is the largest in the state in terms of both annual harvest and number of participants. To ensure effective management, accurate estimates of subsistence harvests in both Alaska and Canada help provide information necessary to assess

the run of a particular salmon species. In January of 2001 the Board of Fisheries adopted Amounts Necessary for Subsistence levels by individual salmon species rather than all salmon species combined. These levels give managers an idea of the normal range of expected subsistence harvest, which is taken into consideration when developing management strategies to utilize any identified harvestable surplus. Summer chum salmon subsisterce harvests arc typically larger in the lower Yukon Area. However, the Upper Yukon Area typically has significantly larger harvests of fall chum and coho salmon compared to the Lower Yukon Area. Typically the chinook salmon subsistence harvest is equally split between Upper and Lower Yukon River areas.

Chinook Salmon

The chinook salmon harvest has remained relatively stable over the last twenty years (Table 1, Figure 6). The chinook salmon harvest decreased noticeably in 2000 due to an extremely poor return in which restrictive management actions were taken. In 2001, management actions taken to conserve summer chum salmon included a restriction to 8 inch or larger mesh size for subsistence gillnets, which may have resulted in a larger harvest of chinook salmon. During the 2002 season, subsistence fishermen reported being able to meet their chinook salmon needs and that the run appeared better than the previous year, yet lower than average numbers were reported for all districts. This may have been due to underreporting of jacks or diseased chinook salmon as part of 2002 subsistence harvest. In 2003, the chinook salmon run began early, was stronger than recent years, and the majority of subsistence fishermen reported they were very satisfied with their harvest.

Summer Chum Salmon

Subsistence harvest of summer chum salmon in the early 80's through 1997 were driven by the commercial roe fisheries in the middle Yukon River Area (Table 1, Figure 7). At the same time the carcasses from the roe fishery provided an ample supply of fish to feed sled dogs. Survey methods were modified to attempt to differentiate between the commercial byproduct from the roe fisheries and what was used for subsistence since 1990. The salmon roe market began declining in 1997 and a series of poor runs occurred from 1998 through 2001. Fishermen in the middle Yukon Area have not had a commercial fishery since 1997 and say that it is not worth their time or gas money to deploy fish wheels for harvesting chum salmon for subsistence in the absence of a commercial fishery. This has likely resulted in lower subsistence harvests of summer chum salmon since 1997. Many of the fish wheels are no longer operable today due to aging.

Due to low abundance, some subsistence fishery restrictions were implemented in 2000 and 2001 to conserve summer chum salmon. In 2001 for the first time on record since 1931 no commercial fishery occurred during the summer season due to both a poor summer chum salmon run and an expected poor run of chinook salmon. In 2002 and 2003, there were enough summer chum salmon for normal subsistence use however, the harvests were still below average.

Fall Chum Salmon

Fall chum salmon subsistence harvests have been greatly affected by extremely weak runs in recent years due to a decline in productivity. The subsistence fishery has been restricted or closed and the commercial fishery was completely closed in 1993, 1998, 2000-2002 in efforts to provide for escapement. The majority of the subsistence harvest is taken from the late portion of the return and the subsistence harvests reflect the reductions placed on them by conservative management and the poor run strength.

The Lower Yukon River Districts 1, 2, and 3 typically account for 10 to 15 percent of the annual fall chum salmon subsistence harvest while Districts 4, 5, and 6 account for 85 to 90 percent (Tabla 1, Figure 8). For most of the run in the lower river, fall chum salmon are sought after as food for people. In the upper river, the early fish are most often used as people food and the later fish are generally put up for dog food. This is because the quality of the flesh decreases as the run progresses and the cold weather late in the fall is better for preserving large quantities of salmon for dog food. In the last three years, management has been conservative with more fishing opportunity allowed very late in the season.

Coho Salmon

Coho salmon run timing overlaps that of the fall chum salmon. Coho salmon fisheries management and harvest are typically dependent upon the actions taken for fall chum salmon. The subsistence harvest decline is directly related to the management actions taken to protect weak returns of fall chum salmon. In some years, harvest of coho salmon was allowed using time, area, and gear (such as fish wheels with live boxes) to target coho salmon. In these years attempts were made to supply some salmon harvest to off set the loss of fall chum salmon therefore the percentage of coho salmon does not reflect as poorly as it would have if the entire fishery would have been closed. Harvest trends for coho salmon are described in Table 1 and Figure 9.

Subsistence Summary

Low salmon runs and subsequent fishery restrictions obviously impact subsistence harvests. Other factors also affect subsistence harvests that are difficult to quantify. As noted for summer chum salmon, low salmon runs that preclude commercial fishing may impact subsistence harvests in the middle Yukon Area. In some areas, lack of commercial fishing may increase the need for fish because of the lack of cash. In other areas, when there is little hope of a commercial fishery, some people feel it is not worth their effort and expense to gear up a fish wheel that would normally be used for both commercial and subsistence or they do not spend their summers in fish camp. Changes in lifestyle, whether due to poor runs or other factors, also impact subsistence harvests. For example, employment opportunities, and numbers of sled dogs and the source of salmon fed to dogs affect harvest levels. Natural events such as flooding and wet weather also play a role.

ESCAPEMENT TRENDS

Overall, chinook salmon biological escapement goals (BEG) were generally met throughout the Alaska portion of the Yukon River drainage in recent years. Biological escapement goals for chinook salmon in the Chena and Salcha Rivers have been met or exceeded in the last three years. The Anvik River chinook salmon BEG was met in 2001,2002, and most likely in 2003 when poor weather precluded a good survey. Chinook salmon BEGs for the Nulato, Gisasa, and Andreafsky Rivers have had mixed successes. However, because of the strong chinook salmon run in 2003, it is felt that all of these BEGs were met. Chinook salmon escapement objectives agreed to and adopted by the Yukon River Panel were met in the Canadian Yukon River mainstem the past three years with 2003, supplanting 2001, being a record escapement.

Achieving escapement goals for Yukon River summer chum salmon run has not been as successful as chinook salmon. Run strength has continued to be poor to below average through the 2003 season. The 2000 and 2001 summer chum salmon runs were two of the worst runs on record. Biological escapement goals for summer chum salmon were not met in the East Fork Andreafsky during the past five years except possibly 2001, which was undetermined because high water prohibited weir operation for a large part of the season. The Anvik River summer chum salmon BEG was not achieved in three of the recent five years (2000,2001, and 2003).

Fall chum salmon run strength has been well below average since 1998, with a dramatic improvement in drainage-wide abundance in 2003. The drainage-wide optimal escapement goal of 350,000 fall chum salmon was met in 2002 and 2003, but was not met in 2000 and 2001. Indiviclual escapement goals for fall chum salmon varied during the 2001 to 2303 time period. The lower end of Sheenjek River's biological escapement goal range was met in 2001. The Chandalar and Delta Rivers as well as the Tanana River proper made their respsctive biological escapement goals in the last three years. The Yukon River Canadian mainstem fall chum salmon objective was met in 2002 and 2003, and the Toklat River BEG was met in 1998,2002, and 2003.

The U.S./Canada Treaty and the Yukon River Panel establish goals for the Fishing Branch River in Canada. The biological escapement goal of 27,000 to 56,000 developed by the department in conjunction with the total run reconstruction analysis in 2000 has not been met in the previous six years however the goal was met in 2003. The Fishing Branch River fall chum salmon stock is addressed each year based on recommendations of the Yukon River Panel under the auspices of the Yukon River U.S./Canada Treaty. For example, the Panel agreed to a stabilization management goal of 15,000 fish for the 2003 season, which was met.

MANAGEMENT ISSUES

Management

Because of the poor runs that began in 1998 for chinook and summer chum salmon, and fall chum salmon prior to 1998, fisheries management has been conservative to meet escapement goals and to provide subsistence opportunity. One of the largest changes that occurred in recent years was the adoption of the subsistence fishing schedule, in 2001. This schedule was

developed to spread the harvest throughout the run to reduce the impact on any particular component of the run, and spread subsistence harvest opportunity among users. It was determined that the schedule should provide reasonable opportunity for subsistence users to meet their needs during years of normal to below average runs.

Management actions for summer chum and chinook salmon have ranged from restricted gear, reduced time, and closed periods, to a regular subsistence fishing schedule with limited commercial fishing opportunity to relaxing the subsistence fishing time beyond the windows schedule. Fall chum salmon management actions have been more severe but have also ranged widely. In 2001, the fall season began with subsistence closed in the lower river then relaxed at midpoint of the run with the upper river having little or no restrictions. The most drastic actions occurred in 2302 when the season started with the subsistence fishing schedule in the lower river, and then the entire river closed near the midpoint of the run in the lower river. This effectively closed fishing in the upper Yukon River before salmon arrived in that area. Similar to chinook salmon, the subsistence fishing schedule during the fall season was relaxed near the midpoint of the run in 2003 with limited commercial fishing opportunity towards the end of the run and subsistence fishing was liberalized beyond the subsistence fishing schedule. These changes in schedules depend on the ability to assess the run based on various monitoring projects throughout the drainage.

Some suspect that overharvesting in the commercial fisheries has caused the poor runs in recent years. However for chinook and summer chum salmon, parent years escapements that produced the very poor runs in 1998-2000 were not overharvested. Escapement goals were achieved in most spawning tributaries during these years and an inadequate number of spawners was not a factor contributing to the poor runs. Recent years of poor runs were from parent year escapements that were near record levels. For fall chum salmon, the poor returns of 1998 through 2002 were also the result of good parent year escapements while the poor escapements in 1998 and 1999 produced the strong run in 2003. Many people attribute the recent poor runs to poor ocean environmental conditions. Weak wildstock returns have occurred throughout Western Alaska and also in Pacific Rim countries as well. There is record of low salmon escapements similar to those observed in 1998-2000, yet those parent years produced good runs.

Recent Issues

Upper Yukon River Area Subsistence Concerns

Since the decline of the runs in 1998 for all salmon species, subsistence fishers have expressed concerns that they have not been able to harvest the amount of fish they need, especially those in the upper portions of the mainstem Yukon River. With the exception of 2000, most of the subsistence fishing issues are driven by the concerns for fall chum salmon. Although some complaints have been heard about chinook salmon subsistence fishing, the last few year's runs into the upper portion of the drainage have been some of the largest observed with 2003 a possible record passage into Canada. The subsistence fishing schedule for Subdistrict 5-D is open seven days a week, twenty-four hours a day. Therefore, concerning chinook salmon, even with record runs and unlimited opportunity, the inability for upper river fishers to harvest their

fish may have to do more with changes in fishing effort and fishing conditions, not run strength.

Declines in the Yukon Area salmon harvest can be most directly attributed to the management actions and subsequent reductions in the fall chum salmon harvest. For fall chum salmon, similar complaints have been voiced that lower river fishers get more opportunity to harvest fall chum salmon than upper river fishers. On average, lower river fishers take only 14 percent of the fall chum salmon subsistence harvest. Even if no subsistence fishing occurred in the lower river, upper river fishers would still fall far short of meeting their needs. Receni runs have been poor and the supply of fall chum salmon has not provided enough fish to meet both escapement and subsistence needs. Further restrictions to lower river fishers in years of poor runs would have done little to provide additional fish for upriver fishermen.

Low salmon runs and subsequent fishery restrictions have obviously impacted subsistence harvests, however there are other factors that may affect subsistence harvests ihat are difficult to quantify. As noted for summer chum salmon, low runs precluding commercial fishing may impact subsistence harvest in the middle Yukon Area. In some areas, lack of commercial fishing may increase the need for fish because of the lack of cash in some instances and for others, lack of cash may make it difficult to pursue subsistence fishing activities. Changes in lifcstylc, whether due to poor runs or non-fishery related factors such as environmental conditions like high water events during the peak of the salmon passage may impact the subsistence harvests. Fishers along the Yukon River have experienced a major upheaval during recent years because of poor runs, reducing subsistence opportunity for some species. Efforts to manage the fishery are focused on maintaining the stocks so that there will be sufficient abundance to build from when production rates return to more normal levels.

Declining Markets

Similar to rest of western Alaska, the Yukon River has also experienced the loss of commercial markets due to declining salmon production in recent years. Transportation is a major factor in moving fish flesh from the dock to distribution centers and markets. Farmed salmon, hatcheries and increasing quantities and varieties of seafood products have given consumers many alternatives to wild salmon at reasonable prices. It is believed that the recent poor Yukon River salmon runs have hurt markets further by not providing a constant supply of salmon which has caused markets to look for fish elsewhere.

Farmed salmon production has increased drastically from virtually nothing in 1980 to 983,000 tons of salmon in 2000, about 58 percent of the world's salmon supply that In that same time period, Alaska has gone from producing 43 percent of the world supply to 19 percent, despite an increase in the harvest-from 231,000 to 320,000 tons. Declining salmon rot: markets are to below profitability levels for the Yukon River. Currently, there is no market for summer chum salmon in the lower Yukon River.

The Yukon River chinook salmon has been the most commercially valuable fish for Yukon River fishers. Because its high oil content, the price per pound has historically been the highest in the state With per pound paid to fishers ranging from $1.95 to $4.57 (average $2.98) for the

lower river ard $.70 to $1.10 (average $0.88) in the upper river in the last 15 years (1989-2003). Although prices remain relatively high for chinook salmon, because of the increased dependency on farmed fish (1% in 1980 to 60% in 2000), buyers desire the best quality for which the markets are demanding.

Summary of Action Plans and Proposals

Action Plans

There are two action items proposed by the department in the 2004 chinook salmon stock status report. One plan is to require subsistence salmon fishing permits in all of Subdistrict 5-C. The second is to require gillnets with greater than 4-inch mesh size to be removed from the water during subsistence salmon fishing closures when the subsistence salmon fishing scheclule is in effect.

The first action item would expand the area required to use permits. Currently, subsistence permits are required in areas with road access. The community of Rampart is scheduled to be connected to 'he road system in 2004, the residents of this community have always been extremely transient and particularly so since the school was closed in this community. The reason to expand the requirement of permits in this area is to collect accurate subsistence harvest information, particularly in an area where potential fishers are difficult to locate and survey post season.

The second action would require gillnets with mesh sizes greater than 4 inch to be removed from the water during subsistence salmon fishing closures. The purpose of this action is to reduce the harvest of salmon to provide for adequate spawning escapement while allowing the harvest of other non-salmon species for subsistence needs. This action will improve enforceability of regulations and remove the necessity of using emergency authority to accomplish this action.

Proposals

There are 17 subsistence, seven commercial, and two sport fishing proposals that will be addressed durng the 2004 Board of Fisheries meeting. Eight of the subsistence fishing regulations pertain to the current subsistence fishing schedule. The proposed changes range from reducing subsistence fishing time in Districts 1, 2, and 3 from 72 hours per week to 36 hours per week with a proposal that eliminates the subsistence fishing schedule for Natives. Two major proposals are 150 and 151, which address changes in the current fall chum salmon management plan, and incorporates the elements of the Toklat River management plan. Three proposals, 161, 162, and 163 all request regulation changes that would extend the use of drift gillnets further up river into the remainder of District 4.

Proposed commercial fishing regulations also vary from closing all commercial fishing on the Yukon River until 2011 to amending the current commercial allocations and reallocating more commercial harvest of chinook salmon to the upper river districts. Two proposals concern the restrictions of gear, mesh size for gillnets and leads for fish wheels.

The sport fishing proposals request allowing catch and release of chinook salmon in the Goodpastor River and to align sport fishing during the same time that subsistence fishing is allowed.

Table 1. Yukon River subsistence salmon harvest by area and total, 1961-2003

	Chinook Salmon			Summer Chum			Fall Chum			Coho		
Year	Districts 1-3	Districts 4-6	Total	Districts 1-3	Districts 4-6	Total	Districts 1-3	Districts 4-6	Total	Districts 1-3	Districts 4-6	Total
1988	12,308	31,599	43,907	72,330	126,278	198,608	15,822	138,991	154,813	13,160	54,670	67,830
1989	16,490	31,956	48,446	105,371	61,784	167,155	15,952	195,195	211,147	10,653	30,058	40,711
1990	20,258	28,329	48,587	74,973	40,636	115,609	13,578	154,322	167,900	10,671	32,789	43,460
1991	16,729	30,044	46,773	54,038	64,502	118,540	10,178	135,346	145,524	6,445	30,943	37,388
1992	17,206	28,420	45,626	67,569	57,928	125,497	14,956	92,646	107,602	13,562	38,359	51,921
1993	28,513	33,973	62,486	66,821	37,955	104,776	12,313	64,449	76,762	4,317	11,455	15,772
1994	21,620	31,457	53,077	63,544	46,360	109,904	9,900	113,318	123,218	7,516	34,178	41,694
1995	20,416	28,119	48,535	74,323	44,400	118,723	9,687	120,819	130,506	5,284	22,941	28,225
1996	18,209	25,097	43,306	67,083	35,420	102,503	12,140	116,726	128,866	6,364	23,948	30,312
1997	23,211	32,767	55,978	64,535	32,574	97,109	8,599	86,542	95,141	5,013	18,932	23,945
1998	21,211	32,522	53,733	59,640	26,364	86,004	9,206	53,661	62,867	4,868	12,904	17,772
1999	25,002	27,192	52,194	50,054	20,269	70,323	11,511	78,225	89,736	5,133	15,684	20,817
2000	19,740	16,101	35,841	53,097	11,798	64,895	7,317	11,989	19,306	3,512	11,205	14,717
2001	26,892	26,167	53,059	50,383	8,002	58,385	7,393	27,761	35,154	2,714	18,940	21,654
2002	18,696	23,924	42,620	50,167	22,093	72,260	3,663	15,727	19,390	2,643	12,598	15,241
2003 [a]												
1993-2002 Avg.	22,351	21,732	50,083	59.965	28.524	88,488	9,173	68.922	78.095	4,736	18,279	23.015
2002 vs. Avg.	-16.4%	-11.7%	-14.9%	-16.3%	-22.5%	-18.3%	-60.1%	-77.2%	-75.2%	-44.2%	-31.1%	-33.8%

[a] Information is not available.

Table 2. Commercial chinook salmon sales and estimated harvest by area, district, and country, Yukon River drainage, 1961-2003.

	Lower Yukon Area[b]				Upper Yukon Area[a]													
					District 4			District 5			District 6			Subtotal			Total		
							Estimated			Estimated			Estimated			Estimated	Estimated	Canada	Grand
Year	District 1	District 2	District 3	Subtotal	Number	Roe	Harvest[c]	Number	Roe	Harvest[c]	Number	Roe	Harvest[c]	Number	Roe	Harvest[c]	Harvest[c]	Total	Total
1961	84,466	29,026	4,368	117,860	-	-		-	-				-	1,804	-	1,804	119,664	3,446	123,110
1962	67,099	22,224	4,687	94,010	-	-		-	-					724	-	724	94,734	4,037	98,771
1963	85,004	24,221	7,020	116,245	-	-		-	-					803	-	803	117,048	2,283	119,331
1964	67,555	20,246	4,705	92,506	-	-		-	-				-	1,081		1,081	93,587	3,208	96,795
1965	89,268	23,763	3,204	116,235	-	-		-	-				-	1,863	-	1,863	118,098	2,265	120,363
1966	70,788	16,927	3,612	91,327	-	-		-	-				-	1,988	-	1,988	93,315	1,942	95,257
1967	104,350	20,239	3,618	128,207	-	-		-	-				-	1,449	-	1,449	129,656	2,187	131,843
1968	79,465	21,392	4,543	105,400	-	-		-	-				-	1,126	-	1,126	106,526	2,212	108,738
1969	71,688	14,756	3,595	90,039	-	-		-	-					988	-	988	91,027	1,640	92,667
1970	56,648	17,141	3,705	77,494	-	-		-	-				-	1,651	-	1,651	79,145	2,611	81,756
1971	86,042	19,226	3,490	108,758	-	-		-	-				-	1,749	-	1,749	110,507	3,178	113,685
1972	70,052	17,855	3,841	91,748	-	-		-	-				-	1,092	-	1,092	92,840	1,769	94,609
1973	56,981	13,859	3,204	74,044	-	-		-	-				-	1,309	-	1,309	75,353	2,199	77,552
1974[d]	71,840	17,948	3,480	93,268	685	-	685	2,663	-	2,663	1,473	-	1,473	4,821	-	4,821	98,089	1,808	99,897
1975	44,585	11,315	4,177	60,077	389	-	389	2,872	-	2,872	500	-	500	3,761	-	3,761	63,838	3,000	66,838
1976	62,410	16,556	4,148	83,114	409	-	109	3,151	-	3,151	1,102	-	1,102	4,662	-	4,662	87,776	3,500	91,276
1977	69,915	16,722	3,965	90,602	985	-	985	4,162	-	4,162	1,008	-	1,008	6,155	-	6,155	96,757	4,720	101,477
1978	59,006	32,924	2,916	94,846	608	-	608	3,079	-	3,079	635	-	635	4,322	-	4,322	99,168	2,975	102,143
1979	75,007	41,498	5,018	121,523	1,989	-	1,989	3,389	-	3,389	772	-	772	6,150	-	6,150	127,673	6,175	133,848
1980	90,382	50,604	5,240	145,626	1,521	-	1,521	4,891	-	4,891	1,947	-	1,947	8,359	-	8,359	153,985	9,500	163,485
1981	99,506	45,781	4,023	149,310	1,347	-	1,347	6,374	-	6,374	987	-	987	8,708	-	8,708	158,018	8,593	166,611
1982	74,450	39,132	2,609	116,191	1,087	-	1,087	5,385	-	5,385	981	-	981	7,453	-	7,453	123,644	8,640	132,284
1983	95,457	43,229	4,106	142,792	MI	-	601	3,606	-	3,606	911	-	911	5,118	-	5,118	147,910	13,027	160,937
1984	74,671	36,697	3,039	114,407	961	-	961	3,669	-	3,669	867	-	867	5,497	-	5,497	119,904	9,885	129,789
1985	90,011	48,365	2,588	140,964	664	-	664	3,418	-	3,418	1,142		1,142	5,224	-	5,224	146,188	12,573	158,761
1986	53,035	41,849	POI	95,785	502	-	502	2,733	-	2,733	950	-	950	4,185	-	4,185	99,970	10,797	110,767
1987	76,643	47,458	2,039	126,140	1,524	-	1,524	3,758	-	3,758	3,338	-	3,338	8,620	-	8,620	134,760	10,864	145,624
1988[e]	56,120	35,120	1,767	93,007	3,159	-	3,159	3,436	-	3,436	762	-	762	7,357	-	7,357	100,364	13,217	113,581
IPS9	61,570[g]	33,166	1,645	96,381	2,790	-	2,790	3,286	-	3,286	1,741	-	1,741	7,817	-	7,817	104,198	9,789	113,987
1990	51,199[h]	33,061	2,341	86,601	3,536	8	3,538	3,353	47	3,365	1,757	1,676	2,156	8,646	1,731	9,059	95,660	11,324	106,984
1991[i]	56,332	39,260	2,344	97,936	2,446	2,222	3,582	3,810	62	3,826	686	1,545	1,072	6,942	3,829	8,480	106,416	10,906	117,322
1992[k]	74,212	38,139	1,819	114,170	1,651	2,273	2,394	3,852	7	3,855	572	884	753	6,075	3,164	7,002	121,172	10,877	132,049
1993	49,286	37,293	1,501	88,080	1,349	701	1,577	3,008	-	3,008	1,113	1,313	1,445	5,470	2,014	6,030	94,110	10,350	104,460
1994	62,241	41,692	1,114	105,047	1216	564	2,443	3,739	10	3,744	2,135	1,820	2,606	8,090	2,394	8,793	113,840	12,028	125,868
1995	76,106	41,458	-	117,564	262	626	499	3,242		3,242	l.a	4,731	2,747	5,164	5,357	6,488	124,052	11,146	135,198
1996	56,642	30,209	-	86,851	45	202	137	2,497	518	2,757	278	750	447	2,820	1,470	3,341	90,192	10,164	100,356
1997	66,384	39,363	-	105,747	1,450	14	1,457	3,678	-	3,678	1,966	3,211	2,728	7,094	3,225	7,863	113,610	5,311	118,921
1998	25,413	16,806	-	42,219	-	-	-	517	-	517	882	260	963	1,399	260	1,480	43,699	390	44,089
1999	37,161	27,133	538	64,832	1,437	-	1,437	2,604	-	2,604	402	1,096	689	4,443	1,096	4,730	69.562	3,160	72,722
2000[m]	4,735	3,783	-	8,518	-	-		-	-							-	8,518	-	8,518
2001[n]					-	-		-	-								-	1,351	1,351
2002[p]	11,159	11,434	-	22,593	-	-	-	771	-	771	836	896	1,066	1,607	896	1,837	24,430	708	25,138
2003[r]	22,750	14,178	-	36,928	562	-	562	1,134		1,134	1,813	-	1,813	2,947		3,509	40,437	8,219	48,656
1993-2002 Avg.	38,913	24,917	315	64,145	676	211	755	2,006	53	2,032	927	1,408	1.269	3,609	1,671	4,056	68,201	5,461	73,662
2003 vs. Avg.	-41.5%	-43.1%	-100.0%	-42.4%	-16.9%		-25.6%	-43.5%		-44.2%	95.5%		42.9%	-18.3%		-13.5%	-40.7%	50.5%	-33.9%

[b] Harvest reported in numbers of fish sold in the round and pounds of roe sold. Since 1990, efforts were made to separate chinook roe from ~~summer~~ chum roe. Does not include department test fish sales

[b] All fish sold in the round. Includes department test fish sales prior to 1988.

[c] The estimated harvest is the fish sold in the round plus the estimated number of females to produce the roe sold.

[d] In 1974, District 4 was subdivided to include Districts 5 and 6.

[e] Includes the illegal sales of 653 chinook salmon in District 5, and 2,136 chinook salmon in District 6.

[f] Includes the illegal sales of 3,211 chinook salmon.

[g] Includes the illegal sales of 1,101 chinook salmon.

[h] Includes the illegal sales of 2,711 chinook salmon in District 1, and 284 chinook salmon in District 2.

[i] Includes the illegal sales of 1,218 chinook salmon in District 1, and 207 chinook salmon in District 2.

[m] No commercial fishing periods in Districts 3,4, 5 and 6.

[n] No commercial fishing periods in Districts 1 through 6.

[p] No commercial fishing periods in Districts 3 and 4.

[r] Data are preliminary.

Table 3. Commercial summer chum salmon sales and estimated harvest by area and district, Yukon River drainage in Alaska, 1967-2003.

	Lower Yukon Area							
	District 1 [b]	Direct 2 [b]	District 3 [b]			Subtotal Lower Yukon [b]		
Year	Number	Number	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]
1967	9,453	1,425	57			10,935		10,935
1968	12.995	1.407	68			14.470		14.470
1969	56.886	5.080				61.966		61,966
1970	117357	19.649				137,006		137.006
1971	93.928	6.112	50			100,090		100,090
1972	114,234	20,907	527			115,668		135,668
1973	221,644	63.402	463			285,509		285.509
1974 [d]	466,004	74.152	1.721			541.877		541.877
1975	418.323	99,139				517.462		517,462
1976	273,204	99,190	9,802			382.196		382.196
1977	250.652	105.679	3.412			359.743		359.743
1978	393,785	227.548	27,003			648.336		648.336
1979	369,934	172,838	40.015			582.787		582.787
1980	191.252	308.704	44.782			744.718		744.738
1981	507,158	351.878	54,471			913.507		9135117
1982	249.516	182.344	4,086			435.946		435.946
1983	451.164	248.092	14,600			713.856		713.856
1984	292,676	236,931	1.087			530.694		530.694
1985	247.486	188.099	1.792			437,377		437,377
1986	381,127	288,427	442			669,996		669,996
1987	222,898	174,876	3.501			401.275		401.275
1988	645,322	424.461	13,965			1,083,748	-	1,083,748
1989	544,373 [f]	343.032	7,578			894.983		894,983
1990	146,725	131.755	643			279.121		279.123
1991	140,470 [h]	175,149	8,912			324.531		324.531
1992 [i]	177,329	147,129	65			324.523		124.523
1993	73,659	19,332	463			93,454	-	93,454
1994	42,332	12,869	35			55,236	-	55,236
1995	142,266	83,817	0			226,083	-	226,083
1996	92,506	30,727	0	935	1,534	123,233	935	124,767
1997	59,915	18,242	-	-	-	78,157	0	78,157
1998	21,270	6,848	-	-	-	28,118	0	28,118
1999	16,181	11,702	0	0	0	27,883	0	27,883
2000 [k]	3,315	3,309	-	-	-	6,624	0	6,624
2001 [m]	-	-	-	-	-	-	-	-
2002	6,333	4,011	-	-	-	10,344		10,344
2003 [p]	3,579	2,583	-	-	-	6,162		6,162
1993-2002 Avg. [r]	50,864	21,206	100	-	-	72,126	-	72,296
2003 vs. Avg.	-93.0%	-87.8%	-100.0%			-91.5%		-91.5%

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	Upper Yukon Area [a]								
	District 4			District 5			District 6		
Year	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]
1967	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-
1974 [d]	27,866	-	27,866	6,831	-	6,831	13,318	-	13,318
1975	165,054	-	165,054	12,997	-	12,997	14,782	-	14,782
1976	211,307	-	211,307	774	-	774	6,617	-	6,617
1977	169,541	-	169,541	1,274	-	1,274	4,317	-	4,317
1978	364,184	16,920	381,104	4,892	605	5,497	34,814	8,236	43,050
1979	169,430	35,317	204,747	8,608	1,009	9,617	18,491	3,891	22,382
1980	147,560	135,824	283,384	456	-	456	35,855	3,282	39,137
1981	59,718	187,032	330,445	1,236	49	1,285	32,477	1,987	34,464
1982	3,647	151,281	257,719	213	21	234	21,597	1,517	23,114
1983	6,672	148,125	255,388	42	1,856	1,898	24,309	18	24,327
1984	1,009	166,842	278,070	645	47	692	56,249	335	56,584
1985	12,007	247,085	427,483	700	-	700	66,913	1,540	68,453
1986	300	269,545	465,535	690	-	690	50,483	2,146	52,629
1987	29,991	121,474	209,800	362	44	406	10,610	450	11,060
1988	24,051	254,526	490,074	722	363	1,085	40,129	1,646	41,775
1989	18,554	283,305	510,244	154	373	527	42,115	4,871	46,986
1990	12,364	105,723	222,550	11	594	671	11,127 [g]	3,059	14,833
1991	6,381	137,232	309,644	4	28	35	18,197	4,716	23,892
1992 [i]	2,659	110,809	211,396	102	295	430	5,029	1,892	7,228
1993	27	22,447	42,957	0	0	0	3,041	515	3,705
1994	3,611	89,717	171,607	229	212	464	21,208	7,828	31,434
1995	8,873	281,074	554,587	107	188	316	24,711	9,475	37,428
1996	0	295,190	510,240	0	302	336	22,360	18,332	46,890
1997	2,062	74,231	124,671	137	0	137	14,886	9,036	25,287
1998	0	0	0	96	13	110	397	140	570
1999	1,267	0	1,267	115	0	115	124	24	147
2000 [k]	-	-	-	-	-	-	-	-	-
2001 [m]	-	-	-	-	-	-	-	-	-
2002	0	0	0	6	-	6	3,198	16	3,218
2003 [p]	62	0	62	-	-	-	4,461	-	4,461
1993-2002 Avg. [r]	1,980	95,332	175,666	86	102	186	11,241	5,671	18,585
2003 vs. Avg.	-96.9%	-100.0%	-100.0%				-60.3%	-100.0%	-76.0%

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Table 3. (page 3 of 3)

Year	Subtotal Upper Yukon Area			Total Yukon River		
	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]
1967	0	0	0	10,935	0	10,935
1968	0	0	0	14,470	0	14,470
1969	0	0	0	61,966	0	61,966
1970	0	0	0	137,006	0	137,006
1971	0	0	0	100,090	0	100,090
1972	0	0	0	135,668	0	135,668
1973	0	0	0	285,509	0	285,509
1974 [d]	48,015	0	48,015	589,892	0	589,892
1975	192,833	0	192,833	710,295	0	710,295
1976	218,698	0	218,698	600,894	0	600,894
1977	175,132	0	175,132	534,875	0	534,875
1978	403,890	25,761	429,651	1,052,226	25,761	1,077,987
1979	196,529	40,217	236,746	779,316	40,217	819,533
1980	183,871	139,106	322,977	928,609	139,106	1,067,715
1981	93,431	189,068	366,194	1,006,938	189,068	1,279,701
1982	25,457	152,819	281,067	461,403	152,819	717,013
1983	31,023	149,999	281,613	744,879	149,999	995,469
1984	57,903	167,224	335,346	588,597	167,224	866,040
1985	79,620	248,625	496,636	516,997	248,625	934,013
1986	51,473	271,691	518,854	721,469	271,691	1,188,850
1987	40,963	121,968	221,266	442,238	121,968	622,541
1988	64,902	256,535	532,934	1,148,650	256,535	1,616,682
1989	60,823	288,549	557,757	955,806	288,549	1,452,740
1990	23,502	109,376	238,054	302,625	109,376	517,177
1991	24,582	141,976	333,571	349,113	141,976	658,102
1992 [f]	7,790	112,996	219,054	332,313	112,996	543,577
1993	3,068	22,962	46,662	96,522	22,962	140,116
1994	25,048	97,757	203,505	80,284	97,757	258,741
1995	33,691	290,737	592,331	259,774	290,737	818,414
1996	22,360	313,824	557,466	145,593	314,759	682,233
1997	17,085	83,267	150,095	95,242	83,267	228,252
1998	493	153	680	28,611	153	28,798
1999	1,506	24	1,529	29,389	24	29,412
2000 [k]	-	-	-	6,624	-	6,624
2001 [m]	-	-	-	-	-	-
2002	3,204	20	3,224	13,548	16	13,568
2003 [p]	4,523	-	4,523	10,685	-	10,685
1993-2002 Avg. [r]	13,307	101,093	194,437	83,954	101,209	245,129
2003 vs. Avg.	-66.0%	-100.0%	-97.7%	-87.3%	-100.0%	-95.6%

[a] Harvest reported in numbers of fish sold in the round and pounds of roe. Roe sales may include some pink and chinook salmon roe. Does not include department test fish sales.

[b] All sales are fish in the round in District 1 and 2. Includes department test fish sales prior to 1988.

[c] The estimated harvest is the fish sold in the round plus the estimated number of females caught to produce the roe sold. In addition, the estimated harvest for Districts 3 and 4 includes the estimated number of unsold males harvested.

[d] In 1974, District 4 was subdivided to include Districts 5 and 6.

[f] Includes the illegal sales of 150 summer chum salmon in District 1.

[g] Does not include 1,233 female summer chum salmon sold in Subdistrict 6-C with roe extracted and roe sold separately These fish are included in estimated harvest to produce roe sold.

[h] Includes the illegal sales of 1,023 summer chum salmon.

[i] Includes the illegal sales of 31 summer chum salmon in District 1, and 91 summer chum salmon in District 2.

[k] No commercial fishing periods in Districts 3, 4, 5 and 6.

[m] No commercial fishing periods in Districts 1 through 6.

[p] Data are preliminary.

[r] Does not include 2000 or 2001.

Table 4. Commercial fall chum salmon sales and estimated harvest by area, district, and country, Yukon River drainage, 1961-2003.

	Lower Yukon Area[1]				Upper Yukon Area[2]														
					District 4			District 5			District 6			Subtotal			Total		
Year	District 1	District 2	District 3	Subtotal	Numbers	Roe	Estimated Harvest [3]	Numbers	Roe	Estimated Harvest [3]	Numbers	Roe	Estimated Harvest [3]	Numbers	Roe	Estimated Harvest [4]	Estimated Harvest	Canada Total	Grand Total
1961	42,461	-	-	42,461	-	-	-	-	-	-	-	-	-	0	0	0	42,461	3,276	45,737
1962	53,116	-	-	53,116	-	-	-	-	-	-	-	-	-	0	0	0	53,116	936	54,052
1963	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	2,196	2,196
1964	8,347	-	-	8,347	-	-	-	-	-	-	-	-	-	0	0	0	8,347	1,929	10,276
1965	22,856	-	-	22,856	-	-	-	-	-	-	-	-	-	461	0	461	23,317	2,071	25,388
1966	69,836	-	1,209	71,045	-	-	-	-	-	-	-	-	-	0	0	0	71,045	3,157	74,202
1967	36,451	-	1,823	38,274	-	-	-	-	-	-	-	-	-	0	0	0	38,274	3,543	41,817
1968	49,857	-	3,068	52,925	-	-	-	-	-	-	-	-	-	0	0	0	52,925	453	53,378
1969	128,866	-	1,722	130,588	-	-	-	-	-	-	-	-	-	722	0	722	131,310	2,279	133,589
1970	208,306	4,653	8,181	208,449	-	-	-	-	-	-	-	-	-	1,146	0	1,146	209,595	2,478	212,074
1971	188,533	-	-	188,533	-	-	-	-	-	-	-	-	-	1,061	0	1,061	189,594	1,781	191,375
1972	136,711	12,698	1,213	150,922	-	-	-	-	-	-	-	-	-	1,254	0	1,254	152,176	2,532	154,708
1973	173,783	45,504	-	219,087	-	-	-	-	-	-	-	-	-	13,003	0	13,003	232,090	2,006	234,096
1974 [5]	179,836	33,548	532	236,128	9,213	-	9,213	28,551	-	28,551	26,884	-	26,884	39,648	0	39,648	284,776	5,544	290,320
1975	158,283	51,666	5,580	215,439	13,646	-	13,646	27,212	-	27,212	18,692	-	18,692	59,578	0	59,578	235,089	2,500	237,589
1976	105,851	21,212	4,250	131,313	1,742	-	1,742	5,167	-	5,167	17,948	-	17,948	25,077	0	25,077	156,390	1,000	157,390
1977	131,758	51,994	15,851	199,603	13,980	-	13,980	28,750	-	28,750	18,673	-	18,673	56,383	0	56,383	255,986	3,990	259,976
1978	127,947	51,646	11,527	191,120	10,988	1,725	12,769	21,016	5,220	26,236	13,259	3,867	16,946	45,263	10,828	55,891	247,011	3,336	250,347
1979	109,496	94,042	25,905	229,443	48,899	5,199	52,098	47,459	8,097	55,556	34,185	5,170	41,355	130,543	18,466	149,009	378,452	9,048	387,498
1980	106,829	83,681	13,519	204,229	25,978	6,947	32,925	41,771	605	42,376	19,452	68	19,520	87,201	3,820	91,021	295,450	9,000	304,450
1981	167,834	154,883	19,043	341,760	12,682	1,101	13,395	86,820	6,995	93,515	23,869	3,019	29,008	124,691	11,283	135,974	477,736	15,260	492,996
1982	97,404	96,381	5,815	199,800	3,894	167	4,061	13,591	42	13,633	6,820	596	7,416	24,305	805	25,112	224,892	11,312	236,204
1983	134,971	85,647	10,018	220,636	4,482	1,963	6,445	43,893	0	43,893	34,849	3,161	37,190	83,364	5,004	87,628	308,662	25,990	333,652
1984	38,751	76,851	6,429	150,983	7,825	2,215	9,840	24,060	57	24,117	29,564	56	29,620	92,249	2,328	94,577	218,560	22,932	233,492
1985	129,948	40,490	5,264	175,662	24,452	2,925	26,977	29,338	9	29,338	42,352	0	42,352	92,142	2,525	94,667	270,269	33,746	304,015
1986	89,552	51,307	2,793	113,452	2,043	0	2,043	23,053	395	23,448	1,891	182	2,074	25,990	577	26,567	140,019	11,464	151,483
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40,591	40,591
1988	66,890	31,845	2,090	78,823	13,662	1,421	17,083	16,989	0	16,989	25,844	1,806	33,658	56,495	3,227	67,722	136,547	30,263	166,810
1989	74,235	97,558	15,332	187,125	11,776	3,407	15,183	19,215	3,993	23,209	48,099	7,353	59,443	79,089	14,769	93,858	280,983	17,549	298,504
1990	25,269	37,877	3,715	66,861	4,989	2,351	6,166	7,738	1,058	8,976	43,152 [6]	7,535	50,973	55,909	10,944	68,117	134,178	27,535	161,713
1991	59,724	102,838	9,213	171,565	5,737	1,616	8,091	27,355	3,625	32,114	28,155	14,154	48,448	39,287	19,395	83,693	254,258	31,464	285,722
1992	0	0	0	0	0	0	0	0	0	0	13,721	2,806	19,022	13,721	2,806	19,022	19,022	18,576	37,598
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,762	7,762
1994	0	0	0	0	0	0	0	3,631	0	3,631	1	1	1	3,276	4,569	3,631	3,276	7,999	7,999	30,033	38,032
1995	70,345	80,821	0	170,176	2,924	4,126	8,731	9,778	18,813	30,033	67,855	9,360	94,117	80,553	32,601	112,881	283,057	39,012	322,069
1996	33,629	29,651	0	63,280	3,918	0	3,918	11,878	8,496	21,658	10,266	6,171	17,574	25,062	14,671	42,370	105,630	20,068	125,699
1997	27,483	24,326	0	51,809	2,458	0	2,458	2,646	1,194	3,959	0	0	0	4,904	1,194	6,378	58,187	8,068	66,255
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	9,967	6,703	0	16,690	661	0	661	0	0	0	0	0	0	661	0	661	20,371	10,402	30,773
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,319	1,319
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,150	2,150
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003 [7]	5,566	0	0	5,566	1,315	0	1,315	0	0	0	4,005	0	4,005	5,410	0	5,410	10,896	7,350	18,246
1993-2002 Avg. [8]	15,044	15,451	0	30,496	898	413	1,479	2,733	2,851	5,944	5,813	1,991	9,806	11,484	5,164	17,029	47,324	11,847	59,171
2003 vs. Avg.	-62.9%	-100.0%		-81.7%	46.4%	-100.0%	-11.1%	-100.0%	-100.0%	-100.0%	-47.6%	-100.0%	-57.4%	-52.9%	-100.0%	-68.2%	-76.9%	-36.9%	-68.8%

Sales reported in numbers of fish sold in the round and pounds of unprocessed roe, which may include small amounts of coho salmon roe. Since 1990, efforts were made to separate coho roe from fall chum roe. Does not include department test fish sales.

[2] All fish sold in the round. Includes department test fish sales prior to 1986.

[3] The estimated harvest is the fish sold in the round plus the estimated number of females to produce the roe sold.

[4] In 1974, District 4 was subdivided to include Districts 5 and 6.

[5] Does not include 484 female fall chum salmon sold in Subdistrict 6-C with roe extracted and roe sold separately. Females are accounted for in the estimated harvest to produce roe sold.

[6] Preliminary.

Table 5. Commercial coho salmon sales and estimated harvest by area and district, Yukon River drainage in Alaska, 1961-2003.

Year	Lower Yukon Area [a]				Upper Yukon Area [b]												Total Estimated Harvest
					District 4			District 5			District 6			Subtotal			
	District 1	District 2	District 3	Subtotal	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]	Number	Roe	Estimated Harvest [c]	
1961	2,855	-	-	2,855	-	-	-	-	-	-	-	-	-	-	-	-	2,855
1962	22,926	-	-	22,926	-	-	-	-	-	-	-	-	-	-	-	-	22,926
1963	5,572	-	-	5,572	-	-	-	-	-	-	-	-	-	-	-	-	5,572
1964	2,446	-	-	2,446	-	-	-	-	-	-	-	-	-	-	-	-	2,446
1965	350	-	-	350	-	-	-	-	-	-	-	-	-	-	-	-	350
1966	19,254	-	-	19,254	-	-	-	-	-	-	-	-	-	-	-	-	19,254
1967	9,925	-	1,122	11,047	-	-	-	-	-	-	-	-	-	-	-	-	11,047
1968	13,153	-	150	13,303	-	-	-	-	-	-	-	-	-	-	-	-	13,303
1969	13,889	-	1,009	14,898	-	-	-	-	-	-	-	-	-	-	-	95	15,093
1970	12,632	-	-	12,632	-	-	-	-	-	-	-	-	-	-	-	556	13,188
1971	12,165	-	-	12,165	-	-	-	-	-	-	-	-	-	-	-	38	12,203
1972	21,705	506	-	22,211	-	-	-	-	-	-	-	-	-	-	-	22	22,233
1973	34,860	1,781	-	36,641	-	-	-	-	-	-	-	-	-	-	-	0	36,641
1974 [d]	13,713	176	-	13,889	0	-	0	1,409	-	1,409	1,479	-	1,479	2,888	-	2,888	16,777
1975	2,288	200	-	2,488	0	-	0	5	-	5	53	-	53	58	-	58	2,546
1976	4,884	17	-	4,881	0	-	0	0	-	0	1,103	-	1,103	1,103	-	1,103	5,984
1977	31,720	5,319	538	37,577	0	-	0	2	-	2	1,284	-	1,284	1,286	-	1,286	38,863
1978	16,460	5,835	758	23,053	32	-	32	1	-	1	3,066	-	3,066	3,099	-	3,099	26,152
1979	11,360	2,920	-	14,219	155	-	155	0	-	0	2,791	-	2,791	2,946	-	2,946	17,165
1980	4,829	2,660	-	7,489	30	-	30	0	-	0	1,226	-	1,226	1,256	-	1,256	8,745
1981	13,129	7,848	429	21,396	0	-	0	0	-	0	2,284	-	2,284	2,284	-	2,284	23,680
1982	15,115	14,179	87	29,381	15	-	15	0	-	0	7,780	-	7,780	7,795	-	7,795	37,176
1983	6,595	2,557	-	9,152	8	-	8	0	-	0	6,168	-	6,168	6,168	-	6,168	15,320
1984	29,472	43,084	621	73,157	1,095	-	1,095	0	-	0	7,688	-	7,688	8,783	-	8,783	81,940
1985	27,676	17,325	171	44,972	938	-	938	0	-	0	11,762	-	11,762	12,700	-	12,700	57,672
1986	24,824	21,197	793	46,814	0	-	0	0	-	0	441	-	441	441	-	441	47,255
1987	0	0	0	0	0	-	0	0	-	0	0	-	0	0	-	0	0
1988	36,028	34,758	1,419	72,205	2	-	2	8	-	8	13,972	-	13,972	13,982	-	13,982	86,187
1989	22,987	38,402	3,988	65,377	3	-	3	84	-	84	16,084	-	16,084	16,171	-	16,171	81,548
1990	12,160	16,485	915	29,483	0	-	0	0	-	0	11,540 [e]	4,042	14,604	11,540	4,042	14,804	44,287
1991	54,095	40,898	1,905	96,898	14	0	14	0	0	0	6,268	4,209	9,774	6,282	4,209	9,788	106,686
1992	0	0	0	0	0	0	0	0	0	0	6,556	1,680	7,979	6,556	1,680	7,979	7,979
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	128	5,588	4,451	128	5,588	4,451	4,451
1995	21,625	18,488	0	40,113	0	0	0	0	0	0	5,826	2,228	6,900	5,826	2,228	6,900	47,013
1996	27,783	20,874	0	48,679	161	0	161	0	0	0	3,803	4,829	7,142	3,964	4,829	7,303	55,982
1997	21,458	13,056	0	34,514	814	0	814	0	0	0	0	0	0	814	0	814	35,328
1998	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
1999	855	746	0	1,601	0	0	0	0	0	0	0	0	0	0	0	0	1,601
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003 [f]	9,757	0	0	9,757	367	0	367	0	0	0	15,119	0	15,119	15,486	0	15,486	25,243
1993-2002 Avg	7,166	5,325	0	12,490	68	0	88	0	0	0	979	1,561	1,899	1,072	1,205	1,917	14,427
2003 vs. Avg	36.2%	-100.0%		-21.9%	276.4%		276.4%				1438.8%	-100.0%	717.0%	1344.3%	-100.0%	707.7%	74.9%

[a] Sales reported in numbers of fish sold in the round and pounds of roe. Since 1990, efforts were made to separate *coho* and fall chum salmon roe. Does not include department test fish sales.
[b] All sales are fish in the round. Includes department test fish sales prior to 1988.
[c] The estimated harvest is the fish sold in the round plus the estimated number of females caught to produce the roe sold.
[d] In 1974, District 4 was subdivided to include Districts 5 and 6.
[e] Does not include 438 female coho salmon sold in District 6-C with roe extracted and roe sold separately. These fish are included in estimated harvest to produce roe sold.

Table 6. Number of commercial salmon fishing gear permit holders who delivered fish, listed by district and season, Yukon Area, 1971-2003

	Chinwk and Summer Chum Salmon Season									Fall Chum and Coho Salmon Season							
	Lower Yukon Area Districts				Upper Yukon Area Districts					Lower Yukon Area Districts				Upper Yukon Area Districts			
Year	1	2	3	Subt.[a]	4	5	6	Subtotal	Total	1	2	3	Subt.	4	5	6	Subtotal	Total
1971	405	154	33	592	-	-	-	-	592	152	-		352				-	352
1972	426	153	35	614	-	-	-	-	614	153	75	1	431				-	411
1973	438	167	38	643	-	-	-	-	643	445	183		628				-	628
1974	396	154	42	592	27	31	20	78	670	322	121	6	449	17	21	22	62	511
1975	441	149	37	627	93	11	16	181	808	428	185	12	625	44	33	33	110	735
1976	453	189	42	684	80	46	29	155	839	422	194	28	644	18	36	44	98	742
1977	192	188	46	626	87	41	18	146	772	137	172	37	546	28	14	32	94	640
1918	429	204	22	655	80	45	35	160	815	429	204	28	661	24	41	30	97	758
1979	425	210	22	657	87	14	30	151	808	458	220	12	710	31	44	17	112	822
1980	407	229	21	657	79	35	31	141	804	395	212	23	650	13	41	26	102	752
1981	448	225	23	696	80	41	26	149	845	462	240	21	721	10	50	10	110	833
1982	450	225	21	696	74	44	20	138	834	445	218	15	678	15	24	25	M	142
1983	455	225	20	700	77	34	25	136	836	312	224	18	554	13	29	21	65	619
1984	444	217	20	613	54	31	27	112	725	327	216	12	536	18	19	26	83	619
1985	425	221	18	666	74	12	27	111	799	345	222	13	159	22	39	25	86	645
1986	441	239	7	672	71	21	27	121	795	282	231	14	510	1	21	16	38	548
1987	440	219	13	659	87	30	24	141	800	0	0	0	0	0	0	0	0	0
1988	456	250	22	678	95	28	31	156	814	328	233	13	561	20	20	32	72	635
1989	445	243	16	687	98	12	29	159	846	312	229	22	550	20	24	28	72	622
1990	453	242	15	679	92	27	23	142	821	301	227	19	529	11	11	27	49	578
1991	489	253	27	678	85	32	22	139	817	319	238	19	540	8	21	25	54	594
1992	418	263	19	679	90	28	19	137	816	0	0	0	0	0	0	22	22	22
1991	618	218	6	682	15	30	18	123	805	0	0	0	0	0	0	0	0	0
1994	414	250	7	659	55	28	20	103	762	0	0	0	0	0	1	11	12	12
1995	439	213	0	661	87	28	21	136	797	189	172	0	157	4	12	20	36	391
1996	448	189	9	627	87	23	15	125	752	158	109	0	263	1	17	17	15	298
1991	457	188	0	619	39	29	15	83	722	176	130	0	304	1	8	0	11	315
1998	414	231	0	643	0	18	10	28	671	0	0	0	0	0	0	0	0	0
1999	412	217	5	611	5	26	6	37	668	146	110	0	254	4	0	0	4	258
2000[f]	350	214		562	-	-	-	-	562			-	-					
2001[e]	-	-			-	-	-					-	-					
2002[f]	121	223	-	540	0	14	6	20	560			-	-					
2003[f,g]	152	217	-	556	1	16	7	26	582	75	-		75	2	-	5	7	82
1993-2002 Avg.	416	225	6	632	49	25	14	88	712	84	65	0	147	2	5	9	15	162
2003 vs. Avg.	-15.4%	-3.4%	-100.0%	-12.1%	-93.8%	-35.7%	-51.5%	-70.5%	-18.2%	-10.3%	-100.0%		-49.1%	33.3%	-100.0%	-42.9%	-53.3%	495%

[a] Since 1984 the subtotal for the Lower Yukon Area was the unique number of permits fished. Prior to 1984, the subtotals are additive for District 1.2, and 3. Some individual fishermen in the Lower Yukon Area may have operated in more than one district during the year.

[b] No commercial fishing periods in Districts 1 through 6.

[c] No commercial fishing periods in Districts 1 through 6.

[d] No commercial fishing periods in Districts 3 and no fish sold in District-4 during summer season. And no commercial fishing periods in Districts 1through 6 during fall season.

[e] No commercial fishing periods in District 1 during summer season, and no commericial fishing periods in Districts 2, 3, 5, and Subdistricts 1A and 6-A during fall season.

[f] Preliminary.

Table 7. Value of commercial salmon fishery to Yukon Area fishermen, 1977-2003.

	Summer Season							Fall Season							
	Chinook			Summer Chum				Fall Chum			Coho				
Year	Lower Yukon Value	Upper Yukon Value	Subtotal	Lower Yukon Value	Upper Yukon Value	Subtotal	Total Season	Lower Yukon Value	Upper Yukon Value	Subtotal	Lower Yukon Value	Upper Yukon Value	Subtotal	Total Season	Total Value
1977	1,841,033	148,766	1,989,799	1,007,280	306,481	1,313,761	3,303,560	718,571	102,170	820,741	140,914	2,251	143,165	963,906	4,267,466
1978	2,048,674	66,472	2,115,146	2,071,434	655,738	2,727,172	4,842,318	691,854	103,091	794,945	96,823	6,105	102,928	897,873	5,740,191
1979	2,763,433	124,230	2,887,663	2,242,564	444,924	2,687,488	5,575,151	1,158,485	347,814	########	83,466	6,599	90,065	1,596,364	7,171,515
1980	3,409,105	113,662	3,522,767	1,027,738	627,249	1,654,987	5,177,754	394,162	198,088	592,250	17,374	2,374	19,748	611,998	5,789,752
1981	4,420,669	206,380	4,627,049	2,741,178	699,876	3,441,054	8,068,103	1,503,744	356,805	########	87,385	4,568	91,953	1,952,502	10,020,605
1982	3,768,107	162,699	3,930,806	1,237,735	452,837	1,690,572	5,621,378	846,492	53,258	899,750	135,828	18,786	154,614	1,054,364	6,675,742
1983	4,093,562	105,584	4,199,146	1,734,270	281,883	2,016,153	6,215,299	591,011	128,950	719,961	17,497	11,472	28,969	748,930	6,964,229
1984	3,510,923	102,354	3,613,277	926,922	382,776	1,309,698	4,922,975	374,359	103,417	477,776	256,050	12,823	268,873	746,649	5,669,624
1985	4,294,432	82,644	4,377,076	1,032,700	593,801	1,626,501	6,003,577	634,616	178,125	812,741	176,254	26,797	203,051	1,015,792	7,019,369
1986	3,165,078	73,363	3,238,441	1,746,455	634,091	2,380,546	5,618,987	399,321	30,309	429,630	211,942	556	212,498	642,128	6,261,115
1987	5,428,933	136,196	5,565,129	1,313,618	323,611	1,637,229	7,202,358	0	0	0	0	0	0	0	7,202,358
1988	5,463,800	142,284	5,606,084	5,001,100	1,213,991	6,215,091	11,821,175	638,700	151,300	790,000	734,400	34,116	768,516	1,558,516	13,379,691
1989	5,181,700	108,178	5,289,878	2,217,700	1,377,117	3,594,817	8,884,695	713,400	223,996	937,396	323,300	33,959	357,259	1,294,655	10,179,350
1990	4,820,859	105,295	4,926,154	497,571	506,611	1,004,182	5,930,336	238,165	174,965	413,130	137,302	37,026	174,328	587,458	6,517,794
1991	7,128,300	97,140	7,225,440	782,300	627,177	1,409,477	8,634,917	438,310	157,831	596,141	300,182	21,556	321,738	917,879	9,552,796
1992	9,957,002	168,999	10,126,001	606,976	525,204	1,132,180	11,258,181	0	54,161	54,161	0	19,529	19,529	73,690	11,331,871
1993	4,884,044	113,217	4,997,261	226,772	203,762	430,534	5,427,795	0	0	0	0	0	0	0	5,427,795
1994	4,169,270	124,270	4,293,540	79,206	396,685	475,891	4,769,431	0	8,517	8,517	0	8,739	8,739	17,256	4,786,687
1995	5,317,508	87,059	5,404,567	241,598	1,060,322	1,301,920	6,706,487	185,036	167,571	352,607	80,019	11,292	91,311	443,918	7,150,405
1996	3,491,582	47,282	3,538,864	89,020	966,277	1,055,297	4,594,161	48,579	45,438	94,017	96,795	13,020	109,815	203,832	4,797,993
1997	5,450,433	110,713	5,561,146	56,535	96,806	153,341	5,714,487	86,526	7,252	93,778	79,973	1,062	81,035	174,813	5,889,300
1998	1,911,370	17,285	1,928,655	26,415	821	27,236	1,955,891	0	0	0	0	0	0	0	1,955,891
1999	4,950,522	74,475	5,024,997	19,687	1,720	21,407	5,046,404	35,639	876	36,515	3,620	0	3,620	40,135	5,086,539
2000	725,606	0	725,606	8,633	0	8,633	734,239	0	0	0	0	0	0	0	734,239
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	1,691,105	20,744	1,711,849	4,342	6,176	10,518	1,722,367	0	0	0	0	0	0	0	1,722,367
2003 [a]	1,871,202	40,957	1,912,159	1,585	6,879	8,464	1,920,623	5,993	3,398	9,391	18,168	5,095	23,263	32,654	1,953,277
1993-2002 Avg	3,259,144	59,505	3,318,649	75,221	273,257	348,478	3,667,126	35,578	22,965	58,543	26,041	3,411	29,452	87,995	3,755,122
2003 vs. Avg.	-42.6%	-31.2%	-42.4%	-97.9%	-97.5%	-97.6%	-47.6%	-83.2%	-85.2%	-84.0%	-30.2%	49.4%	-21.0%	-62.9%	-48.0%

[a] Preliminary.

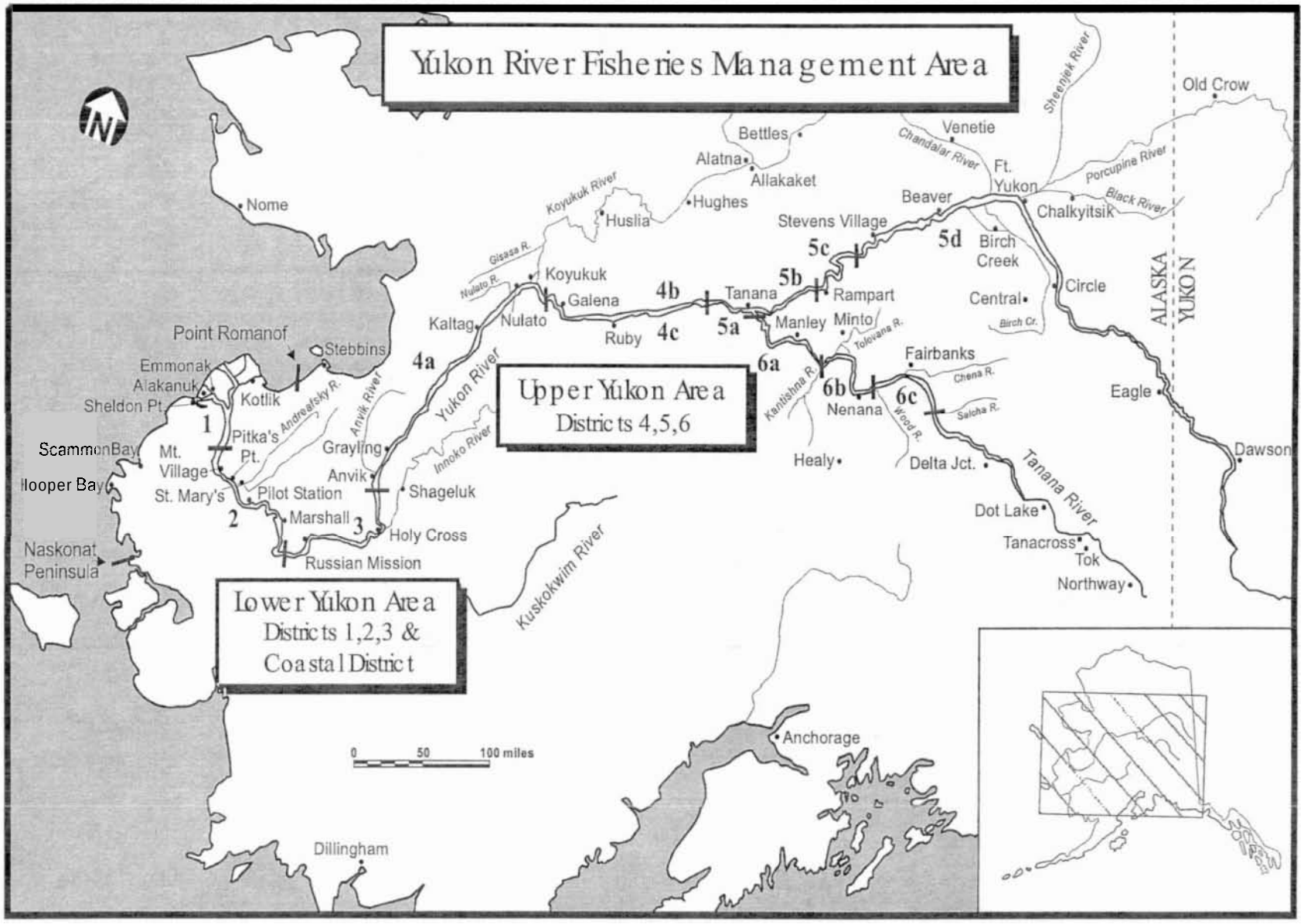

Figure 1. The Yukon Area showing communities and fishing districts.

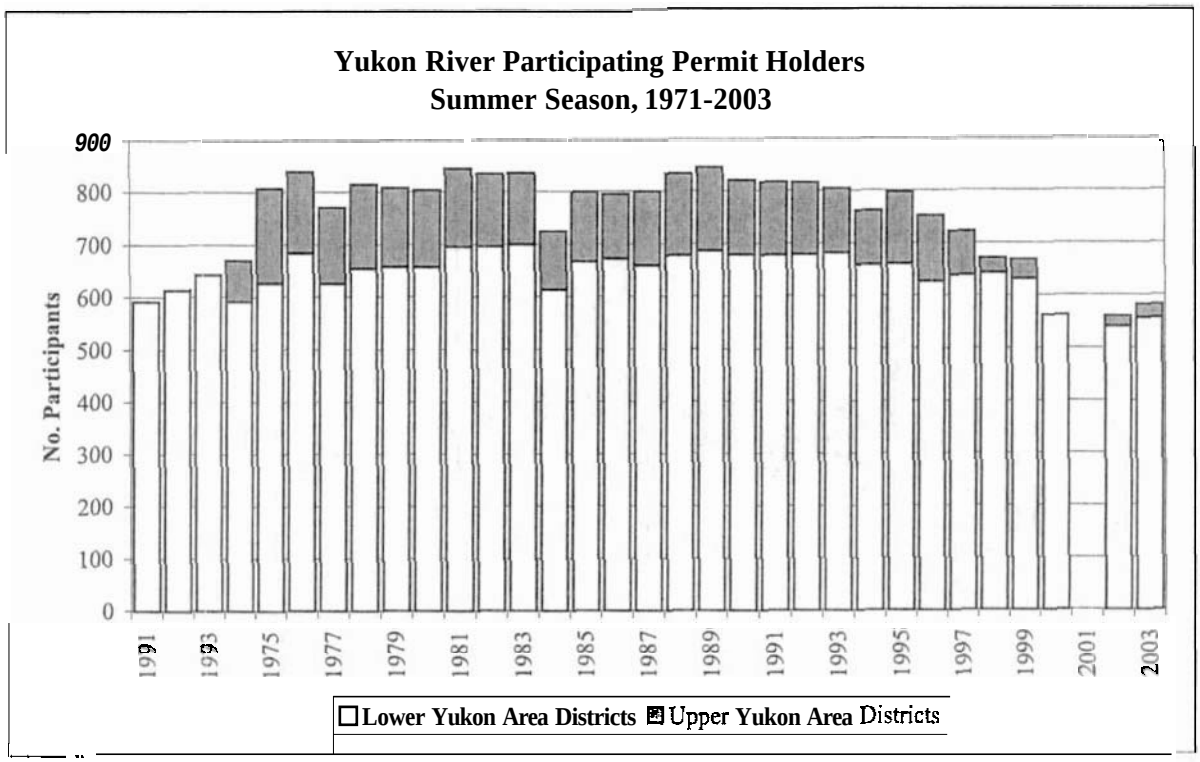

Figure 2. Number of active permit holders from lower and upper Yukon River fishers, summer season 1971-2003. No commercial fishing occurred in 2001.

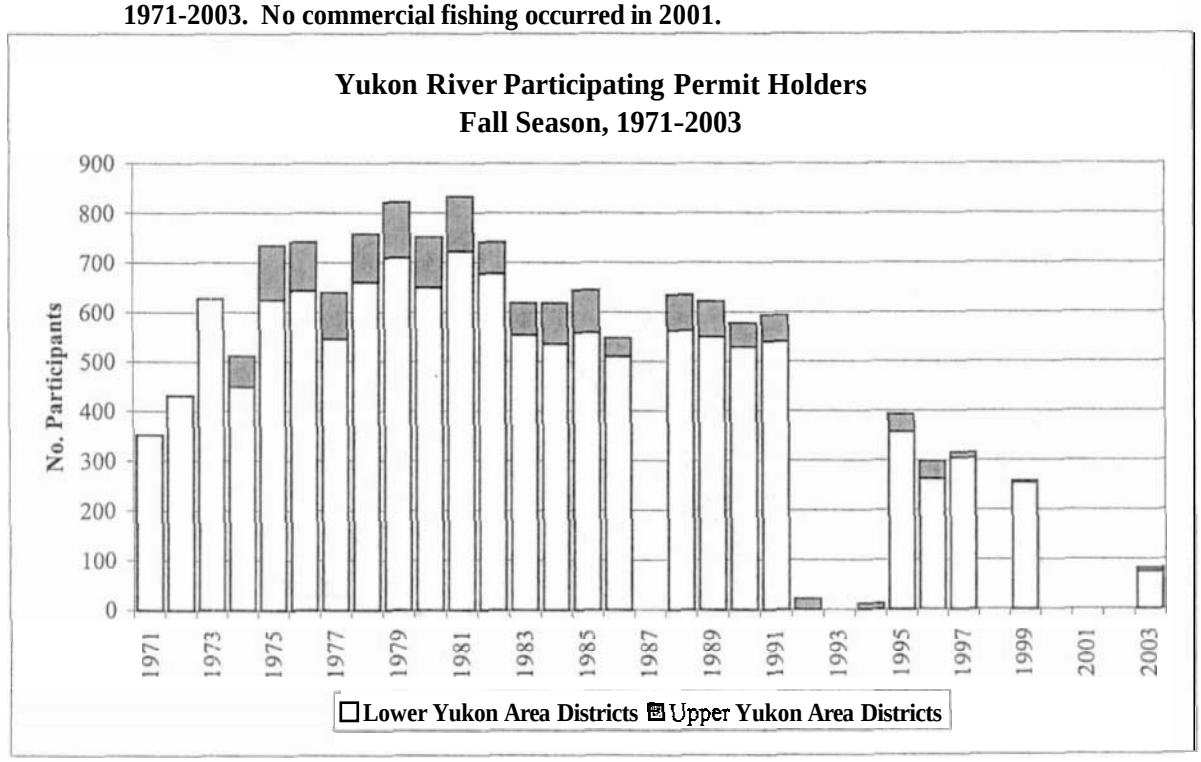

Figure 3. Number of active permit holders from lower and upper Yukon River fishers, fall season 1971-2003. No commercial fishing occurred in 1987, 1993, 2000, 2001, and 2002.

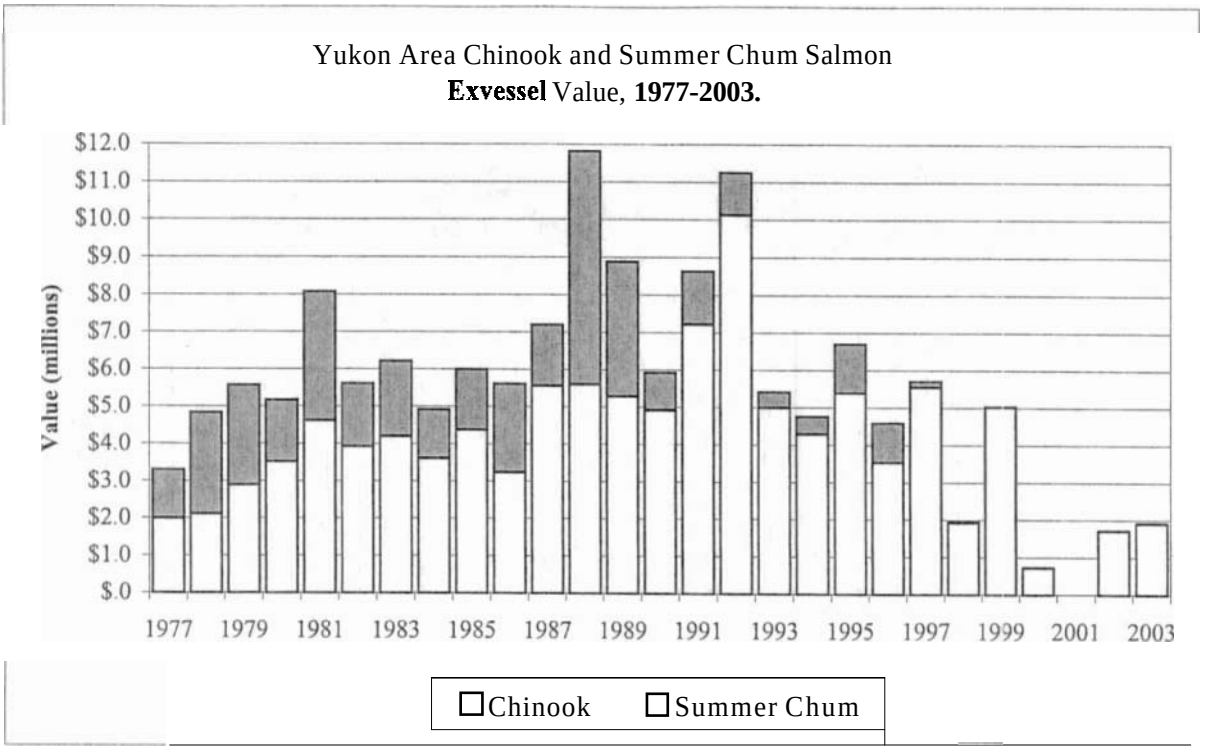

Figure 4. Exvessel value of commercial chinook and summer chum salmon fishery to Yukon Area fishermen, 1977-2003. No commercial fishing occurred in 2001.

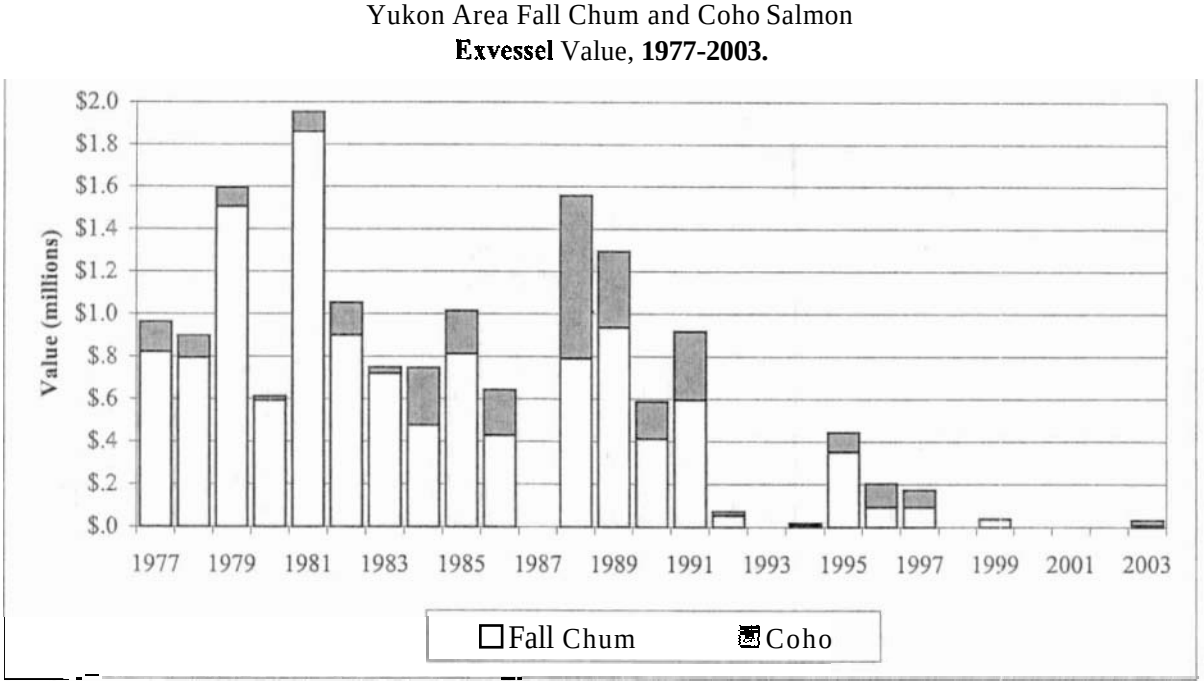

Figure 5. Exvessel value of commercial fall chum and coho salmon fishery to Yukon Area fishermen, 1977 2003. No commercial fishing occurred in 1987,1993, 1998,2000,2001, and 2002.

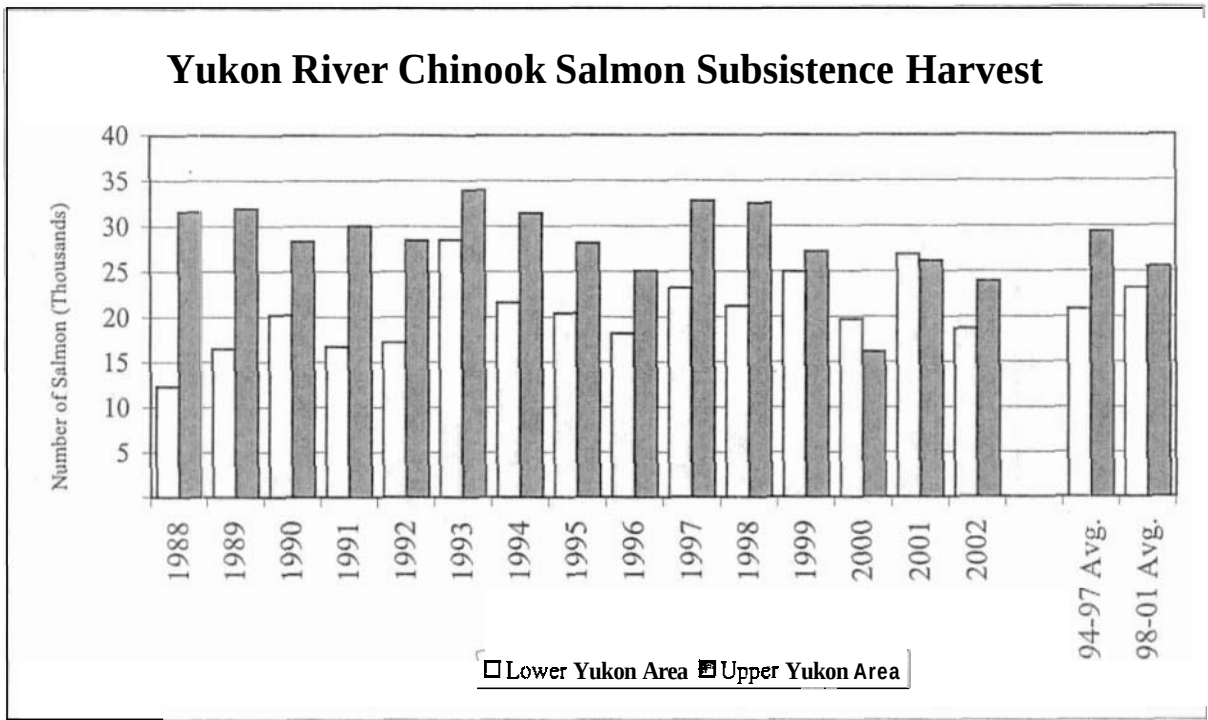

Figure 6. Yukon River chinook salmon estimated subsistence harvests, 1988-2002 with the 1994-1997 and 1998-2001 averages.

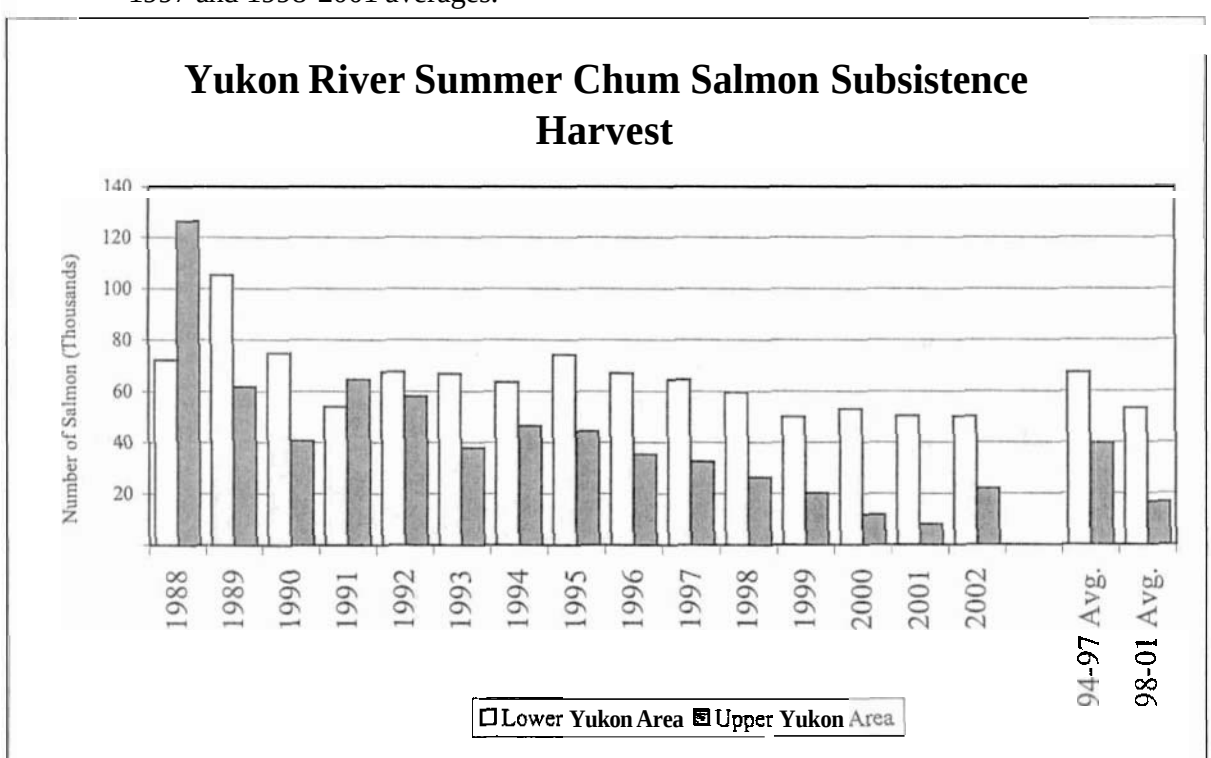

Figure 7. Yukon River summer chum salmon estimated subsistence harvests, 1988-2002 with the 1994-1997 and 1998-2001 averages.

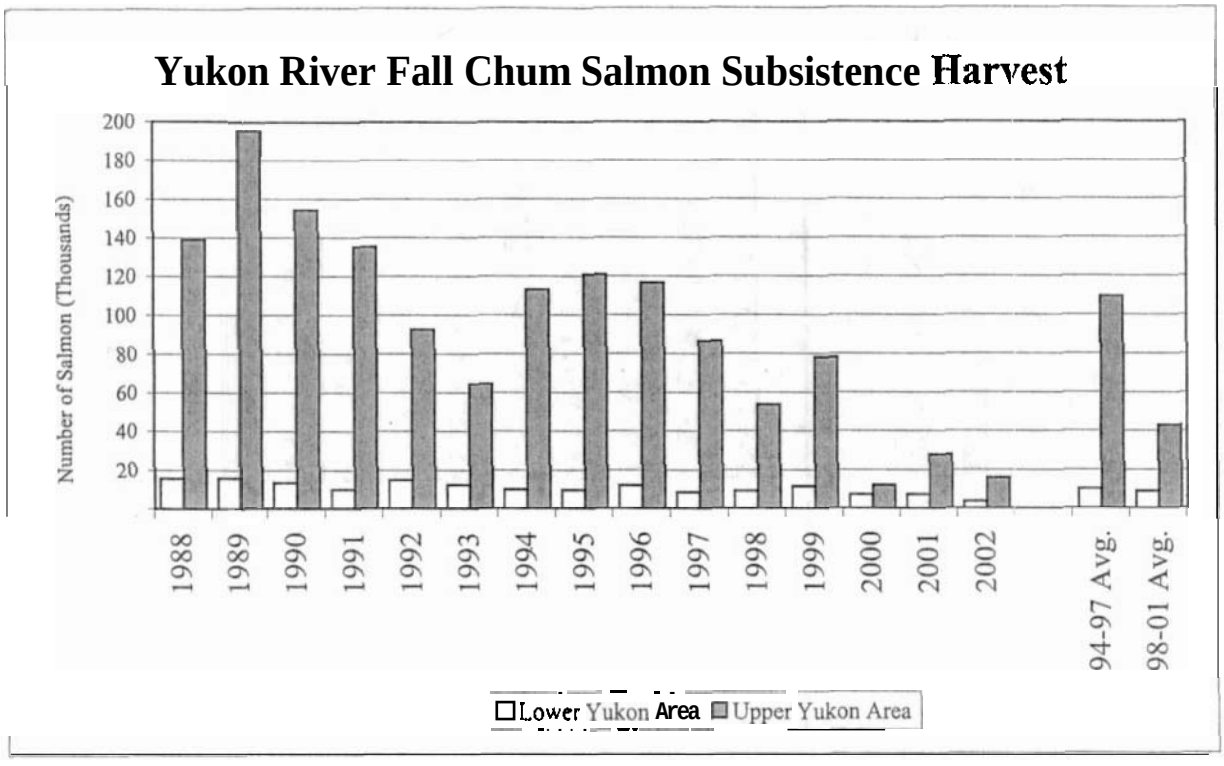

Figure 8. Yukon River fall chum salmon estimated subsistence harvests, 1988-2002 with the 1994-1997 and 1998-2001 averages.

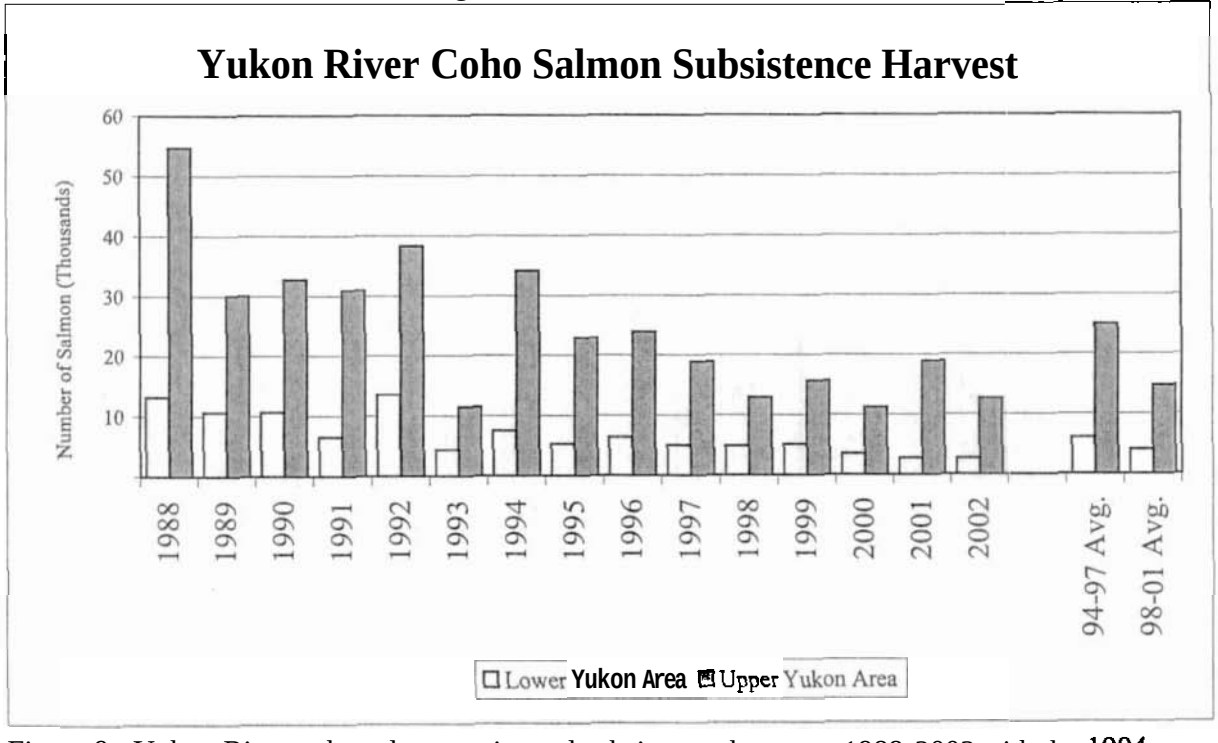

Figure 9. Yukon River coho salmon estimated subsistence harvests, 1988-2002 with the 1994-1997 and 1998-2001 averages.

EVALUATION OF HYDROACOUSTIC SITE ON THE YUKON RIVER TO MONITOR PASSAGE OF SALMON ACROSS THE US/CANADA BORDER, 2003

By

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And

Daniel C. Huttunen

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Commercial Fisheries Division
AYK Region
333 Raspberry Road
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OFFICE OF EQUAL OPPORTUNITY (OEO) STATEMENT

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ABSTRACT

A set of 21 transects was collected near the village of Eagle, Alaska on August 5, 2003 in an attempt to find a suitable location to eventually deploy sonar to count migrating salmon. The site with the greatest potential was located just downriver of Calico Bluff (N64° 55.870' W141° 10.374'). The river bottom at this site was linear on both banks with a substrate consisting relatively of small cobble. The profile and bottom substrate at this location should be conducive to counting salmon and to allow full river coverage with sonar. Further investigations should focus on determining the spatial distribution of fish passing the site and the relative contribution of resident species to the total count.

KEY WORDS: salmon, sonar, hydroacoustic, global positioning system, Eagle, Yukon River

INTRODUCTION

The Yukon River flows over 1,700 miles through Alaska and Canada. Commercial and subsistence fisheries harvest salmon throughout most of the drainage. These salmon fisheries are critical to the way of life and economy of people in dozens of communities along the river, in many instances providing the largest single source of food or income. Management of the fisheries on this river is complex and difficult because of the number, diversity, and geographic range of fish stocks and user groups. Information upon which to base management decisions come from several sources, each of which has unique strengths and weaknesses. Gillnet test fisheries near the mouth provide inseason indices of run-strength, but interpretation of these data is confounded by gillnet selectivity and changes in net site characteristics. Also, the functional relationship between test-fishery catches and abundance is unknown. Mark-recapture projects provide estimates of total abundance, but the information is typically not timely enough to make day-to-day management decisions.

Further exacerbating the need for accurate abundance estimates are recent US/Canada treaty agreements that specify numbers of chinook and chum salmon that must be passed into Canada. Accurate abundance estimates not only help managers adjust harvest in season, they are also used post season to determine whether treaty obligations were met.

In 1992, a project was initiated near the village of Eagle, Alaska to examine the feasibility of using split-beam sonar to estimate the number of salmon migrating across the US/Canada border (Johnston et al. 1993, Konte et al. 1996). This project was the first documented use of split-beam sonar in a riverine environment, and over the three-year duration of the study a number of problems were identified. Phase corruption was observed and was likely exacerbated by the highly reflective bottom (Konte et al. 1996). The errors in the phase measurement were believed to have resulted in overly restrictive echo angle thresholds. Echoes from fish that were physically within accepted detection regions were automatically removed from the data files because of errors in angle measurement. Other equipment issues reflected the early state of development of the new equipment, most of which have since been addressed.

The first of a number of recommendations from the previous studies was to find a better site with smaller rocks and a smoother bottom profile (Johnston et al. 1993). The large rocks may have further compromised fish detection by limiting how close to the bottom the beam could be aimed. Secondly, reverberation from the large rocks may have caused phase perturbation increasing errors in position measurements. Thirdly, the uneven bottom (Figure 1) may have allowed fish to pass undetected by the sonar, and a more linear profile would alleviate this problem and allow detection of fish at longer ranges. Sampling longer ranges at the 1992 project site would have required additional equipment, increasing the complexity and expense of the project (Johnston et al. 1993).

Additionally, it was thought the project would benefit by gaining a better understanding of behavior and spatial distribution of the fish passing the Eagle site. Gillnets were used to look at species composition but drifting was deemed too difficult because of high water velocities.

Consequently, set gillnets were deployed downstream of the site with a recommendation to deploy set gillnets upstream of the sonar in the future. The last recommendation was a wide variety of mesh sizes should be used to obtain a less biased sample of all species present (Johnston et al. 1993).

The objective of this study was to identify a suitable location on the Yukon River to deploy hydroacoustic equipment to detect chinook and fall chum salmon migrating into Canada. Considering the recommendations of past work, criterion for a suitable site was linear bottom profiles on both sides of the river without large, angular rocks that can make fish detection problematic.

METHODS

Bottom profiles were collected with a Lowrance X-15 fathometer[2] with attached Global Position System (GPS). The GPS was able to obtain a Wide Area Augmentation System (WAAS) signal to enhance the resolution of the position measurements. Typical WAAS correction allows position measurements accurate to within 3 meters 95% of the time. For each transect, an attempt was made to keep ground velocity constant and the path straight. Constant velocity was not a requirement since the paired depth and positional information allowed for uneven boat velocity, but does help when viewing the uncorrected transect images in the field. Transects were taken starting at White Rock in Canada proceeding downriver to a sandbar below Calico Bluff in Alaska (Figure 2).

RESULTS

A total of 21 transects (not including aborted attempts) was completed on August 5,2003 (Table 1, Appendix A). Of these transects, two sites were noted as having the greatest potential for sonar deployment. Charts 26, 27 and 28 were taken near Shade Creek and show a linear bottom on each side of the river (Appendix A). Chart 32 taken just down from Calico Bluff also had a linear bottom profile with the advantage the substrate on this bank appeared to consist of smaller cobble than was observed near Shade Creek. The site with the most potential on the Canadian side of the border appeared to be the location of Chart 16. Chart 16 displayed a linear profile, however, the presence of a small channel on the south bank of the river, as evidenced in Chart 17, presents a significant challenge to any potential full river sampling at this site.

[2] Mention of a company's name does not constitute endorsement by ADF&G.

DISCUSSION

The site with the apparent greatest potential to successfully detect migrating salmon is just downstream from Calico Bluff (13 miles downriver of the village of Eagle). The bank profile there is linear outward from each bank with a slight flat spot in the thalweg. It should be possible to ensonify the full width of the river from the banks at this site using split-beam sonar on the left (west) bank and a long range DIDSON (new imaging sonar) on the right (east) bank (Figure 3). Full river coverage would also be possible near Shade Creek using the same equipment. The advantage of the Calico Bluff location is the river substrate appeared to be composed of smaller rocks than at Shade Creek. This appearance was inferred from the size of exposed rocks near the waterline although it is possible that substrate composition further from shore may differ. The less reflective substrate will make possible aiming the sonar beam close to the bottom to result in better fish detection, which showed a strong tendency to bottom orientation in the previous study.

The site in Canada with the best profile (Appendix A, Chart 16) has potential, but the presence of the small channel on the side opposite an island could be problematic. Even during the low water experienced during this study, the secondary channel had flowing water (Appendix A, Chart 17). Although a weir could prevent fish from utilizing this channel at low water, to completely block the channel during periods of normal or high water may be impossible (or impractical).

The next step in project development will be to determine the spatial fish distribution and the relative contribution of non-salmon species at the new site. Spatial distribution will ultimately dictate equipment selection. If the relative abundance of other species is sufficiently high, the project leader will ultimately have to consider methods of species apportionment such as those employed at the ADF&G sonar project near Pilot Station, AK (Pfisterer 2002).

To the extent possible, we will investigate the feasibility of utilizing the DIDSON sonar at the chosen site. The DIDSON is an imaging sonar that was developed by the University of Washington's Applied Physics Laboratory (APL) to aid the military in detecting submerged explosives (Belcher personal communication). During the summer of 2002, the Department contracted APL to test the DIDSON in Alaskan rivers. In attendance were numerous sonar experts and users including Tim Mulligan, formerly of the Department of Ocean and Fisheries, Canada; Debby Burwen, ADF&G Sonar Biologist; Nancy Gove, ADF&G Biometrician; Don Degan of Aqacoustics; Anna-Marie Mueller of Aquacoustics; Ted Otis, ADF&G Fishery Biologist; Lee McKinley, ADF&G Fishery Biologist; Dan Huttunen, ADF&G Sonar Biologist; and Suzanne Maxwell, ADF&G Sonar Biologist. The researchers thought the DIDSON was easy to use and not subject to many of the limitations of other sonar devices. With the DIDSON it was possible to count fish at high densities, easily determine direction of travel, and obtain body length information on targets. At the same time, the equipment was easy to operate, and the software was user friendly and robust (Maxwell 2002).

The Department purchased a DIDSON sonar for the Aniak River in 2003 to begin the process of transitioning this project to the newer equipment. As part of the transition, the DIDSON was operated simultaneously and adjacent to the existing dual-beam system for approximately three

weeks to compare passage estimates resulting from the two systems (Sandall In press). Preliminary results indicate the DIDSON better distinguishes individual fish at high densities and the effect is a density-dependent, negative bias of the dual-beam passage estimates (Figure 4).

Given these experiences, we think the DIDSON will enable the Yukon project to obtain the best estimates possible at the same time providing ease of use not available with any other system. The primary limitation of this system is the maximum range is limited to about 60 m. Full river coverage with this system would be at the least impractical, if not impossible to obtain. If chinook and chum salmon are found to be predominately bank oriented at this site, it may be possible to count the majority of the fish using one DIDSON on each bank while sampling the middle of the channel using split-beam equipment. Another possible sampling scenario, would be to use split-beam sonar on the left (west) bank, and DIDSON on the right (east) bank, as depicted in Figure 3. The appropriate sampling approach will be made once more is known about the spatial distribution of fish passing the site.

In summary, we were encouraged by the bottom profiles obtained by this study. Two potential locations for sonar deployment were both downstream of Eagle, AK. The preferred site was located near Calico Bluff. The profile at this location was linear over most of the channel and from what we could see of the substrate, should allow good detection of fish with minimal bottom interference. Given the width of the river and the profile of the bottom, it may well be possible to obtain full river coverage using a single sonar on each bank. Therefore, coupled with the apparent stability of this site, we think further research into its potential use as an acoustic-based salmon passage assessment project location is warranted.

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Table 1. Locations and notes from transects taken near Eagle, Alaska, 2003.

Transect Name	Description	GPS Location	Comments
Chart 10	At White Rock	N64° 37.715' W140° 52.501'	Aborted
Chart II	At White Rock	N64° 37.715' W140° 52.501'	Mid-River towards shore (fishwheel)
Chart 12	At White Rock	N64° 37.715' W140° 52.501'	Shore-to-shore from fishwheel. Lost bottom when got near island
Chart 13	At White Rock	N64° 37.715' W140° 52.501'	Shore-to-shore, south bank ->north bank
Chart 14	At island down from DFO camp	N64° 40.319' W140°53.861'	North bank -> south bank
Chart 15	At island down from DFO camp	N64° 40.319' W140°53.861'	Same as 14, north -> south bank
Chart 16	Just down from 14&15	N64° 40.385' W140° 53.888'	Much better, no sub-channels on the north bank. This was just off a small gravel point
Chan 17	Inside island near 16	N64° 40.537' W140° 54.947'	Channel on opposite side of Chart 16. Narrow, about 40 yards in length, <3' depth
Chart 18	None	N64° 40.836' W140°57.742'	South -> north bank. At end of file we turned around, it doesn't actually get deeper again!
Chart 19	Just down from 18		North bank >south bank. About a mile on the Canadian side.
Chart 20	None	N64° 41.062' W140° 57.477'	Up above rock point. North -> south bank. Good south bank profile
Chart 21	At border	N64° 40.894' W140° 59.996'	South -> north bank. Not very good profile
Chart 22	Few hundred yards down from border	N64° 40.976' W141° 00.612'	Not a very good profile
Chart 23	Just upriver of Eagle	N64° 46.541' W141° 04.638'	South -> north bank. File was stopped late; the bottom goes straight up to the shore.
Chart 24	Shade Creek	N64° 53.222' W141°07.619'	South -> north bank. Pretty flat across the majority of the channel.
Chart 25	Just up of 24		Not a favorable profile
Chart 26	Up of 25	N64° 53.165' W141° 06.892'	South ->north bank. Ended file late but looks like a pretty good profile.
Chart 27	Same as 26	N64° 53.165' W141° 06.892'	Repeated 26 but going north -> south bank. Good profile! Width ~300m
Chart 28	Upstream of 27	N64° 53.126' W141° 06.602'	Profile fairly linear

Table 1, continued.

Transect Name	Description	GPS Location	Comments
Chart 29	Calico Bluff	N64° 54.289' W141° 11.560'	East -> west bank. Not a good profile.
Chart 30	Down from 29		Aborted, lost bottom
Chart 31	Near 30	N64° 54.742' W141° 11.292'	West -> east bank. Good chart but bottom is rounded.
Chart 32	Sand bar downstream from Calico Bluff	N64°55.870' W141° 10.374'	West -> east bank. Width ~350m. Good profile, perhaps best. A bit of an island to the west but would have to have high water to get enough water to have a channel

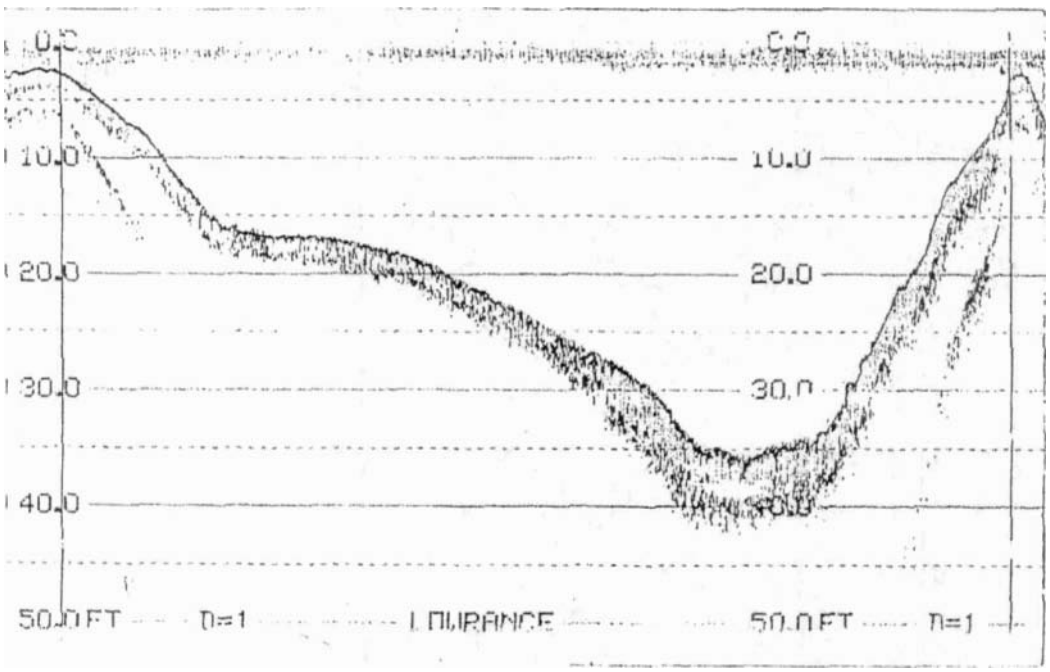

Figure 1. Bottom profile at the Eagle sonar site, 1994. Reproduced from Konte et al. 1996.

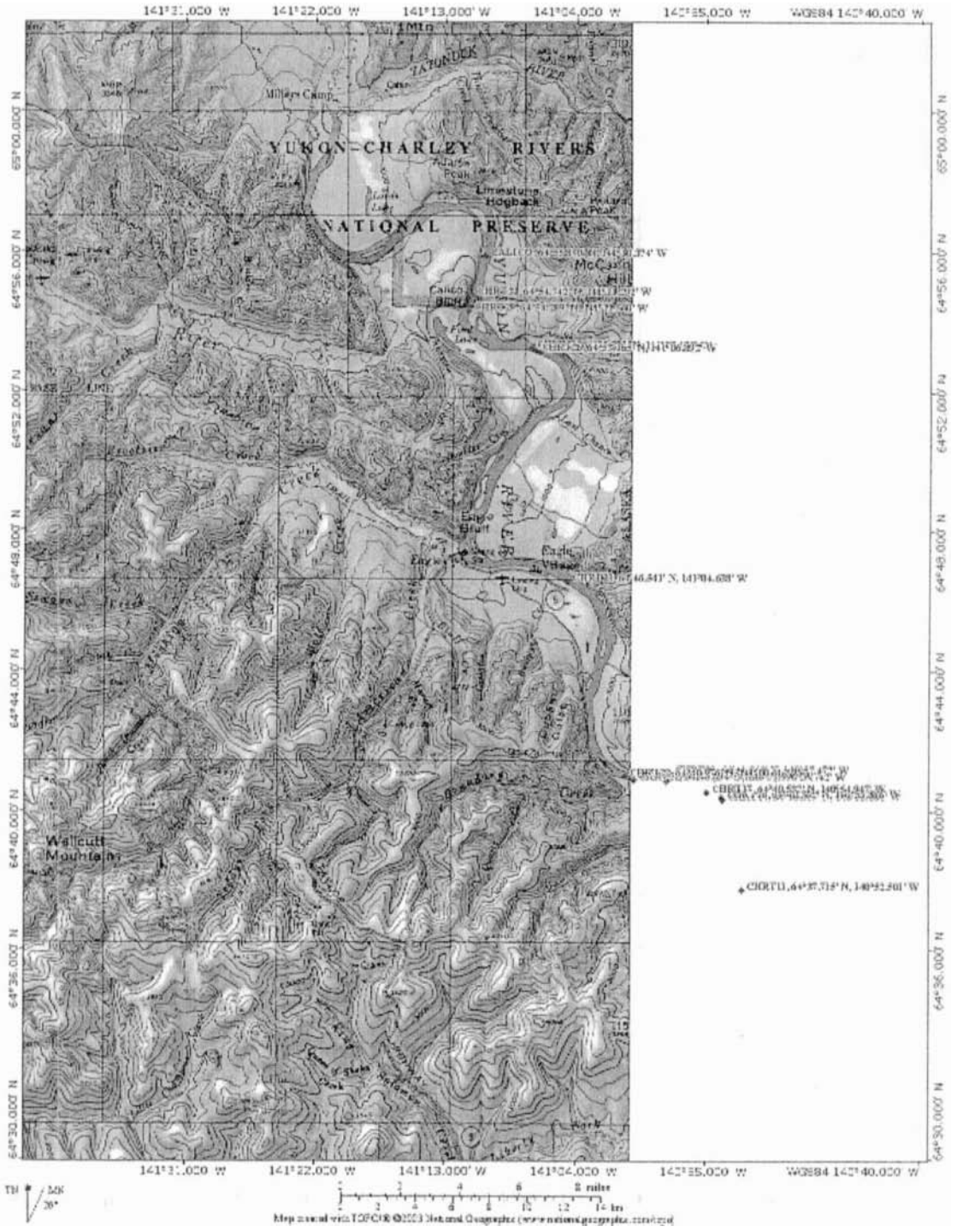

Figure 2. Locations (blue) of transects near the US/Canada border, 2003.

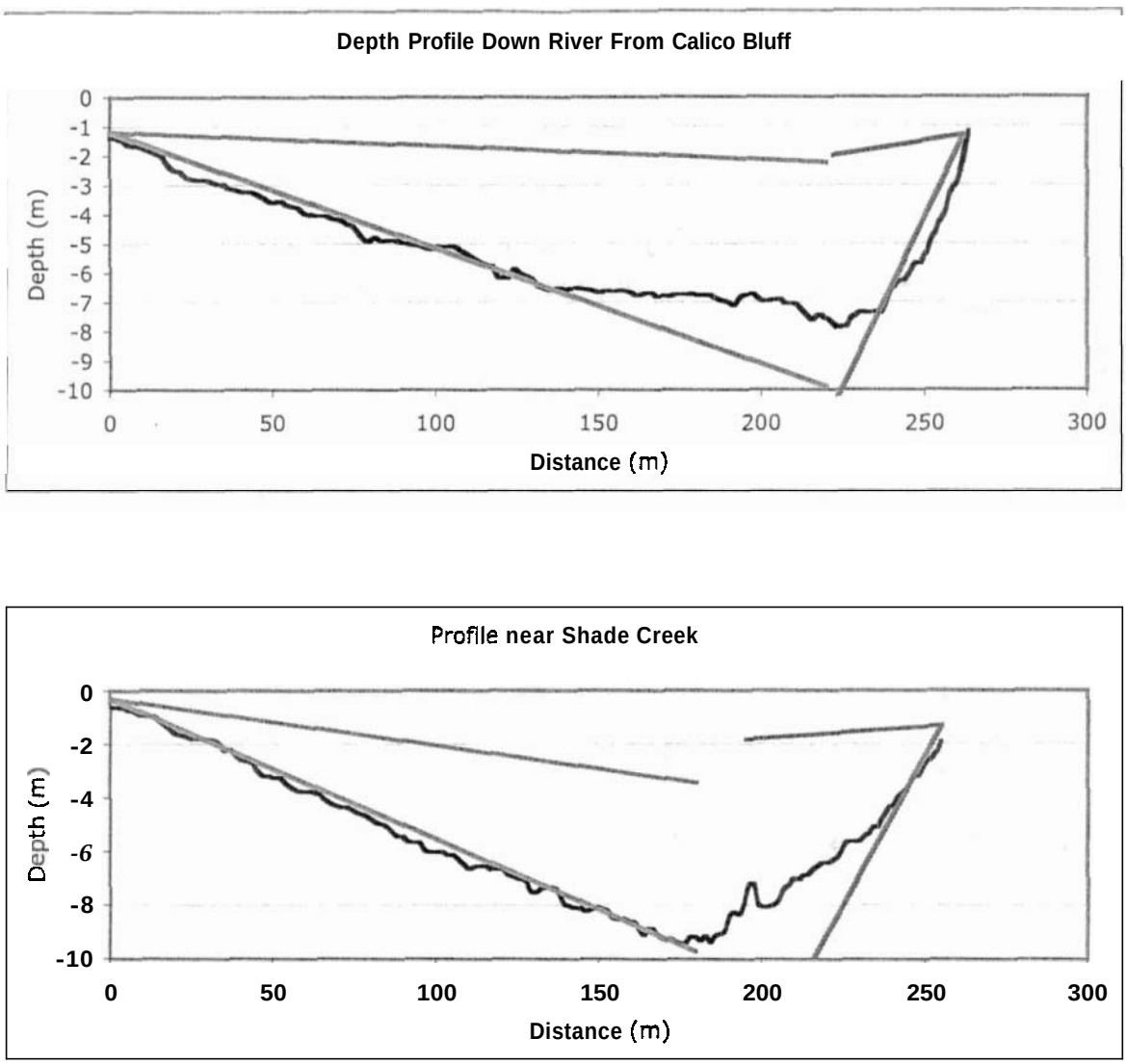

Figure 3. Depth profiles taken near Calico Bluff (top) and Shade Creek (bottom) overlaid with 2° split-beam (green) and 12° DIDSON (red) beams.

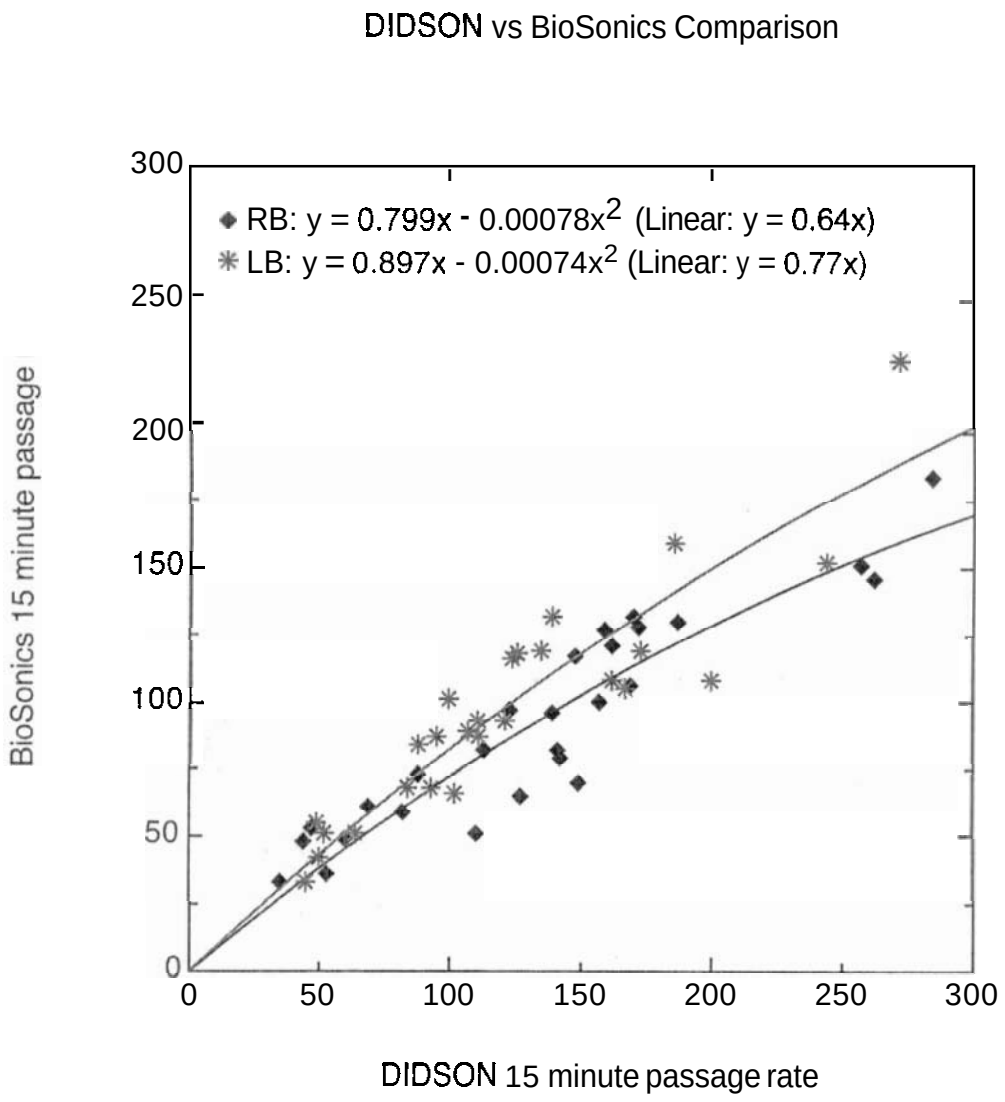

Figure 4. Preliminary right bank (red) and left bank (blue) side-by-side comparisons of 15-minute counts produced by the BioSonics (dual-beam) and DIDSON sonars, Aniak 2003.

Appendix A. Yukon River bottom profiles

Chart 1I: White Rock, started out from shore then proceeded in.

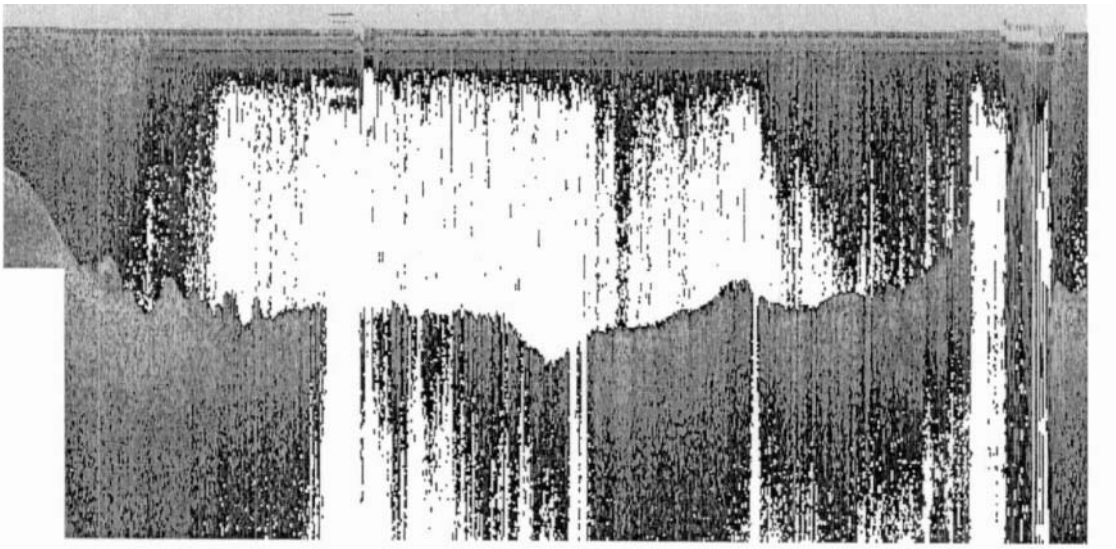

Chart 12: White Rock. Shore-to-shore out from the fishwheel. Lost bottom when we got near the island.

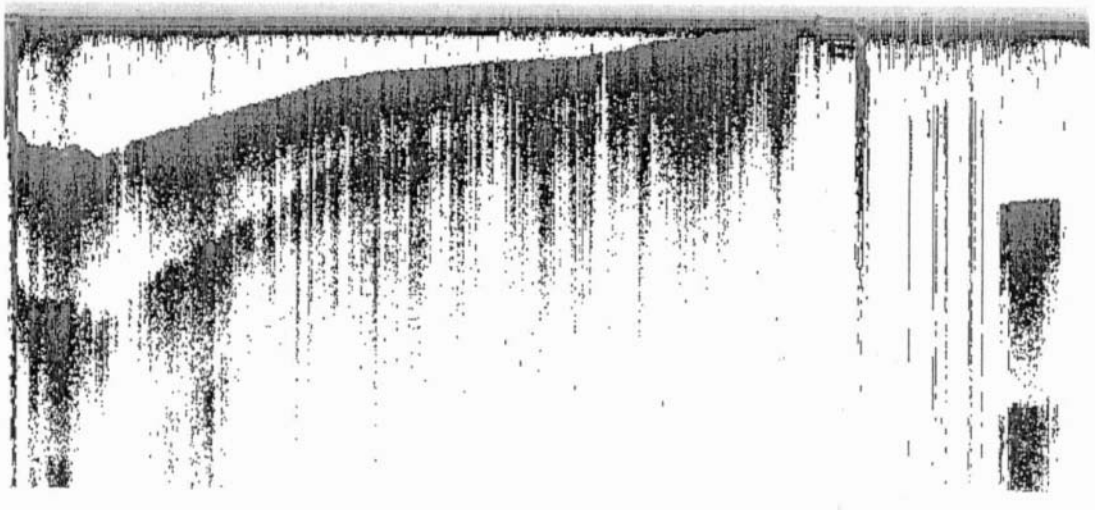

Chart 13: White Rock. Shore to Shore, south bank to north bank

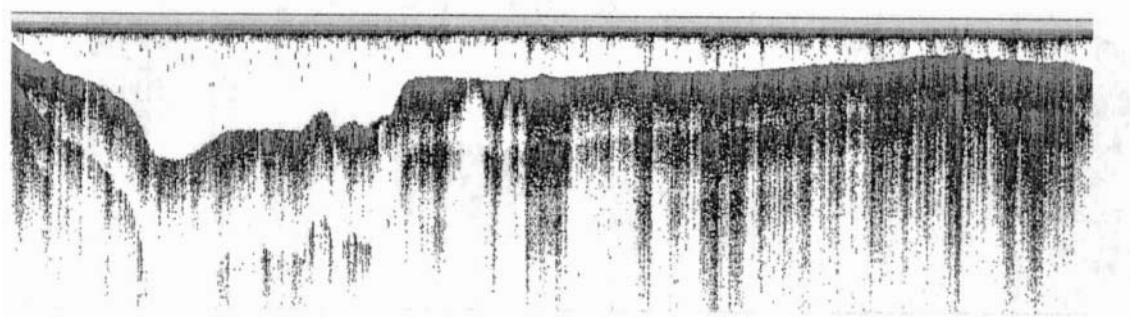

Chart 14: N64°40.319', W148°53.861'. North to south bank at island down from DFO camp

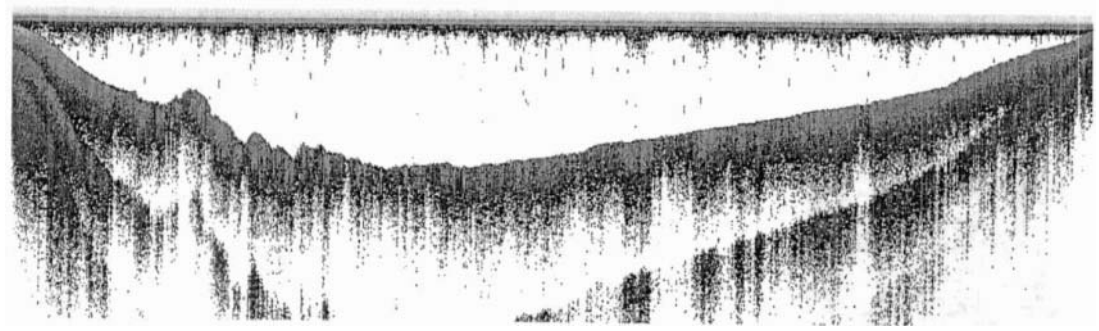

Chart 15: Same as 14 but from south bank to north bank. Lost bottom initially but picked it up at 9' of depth

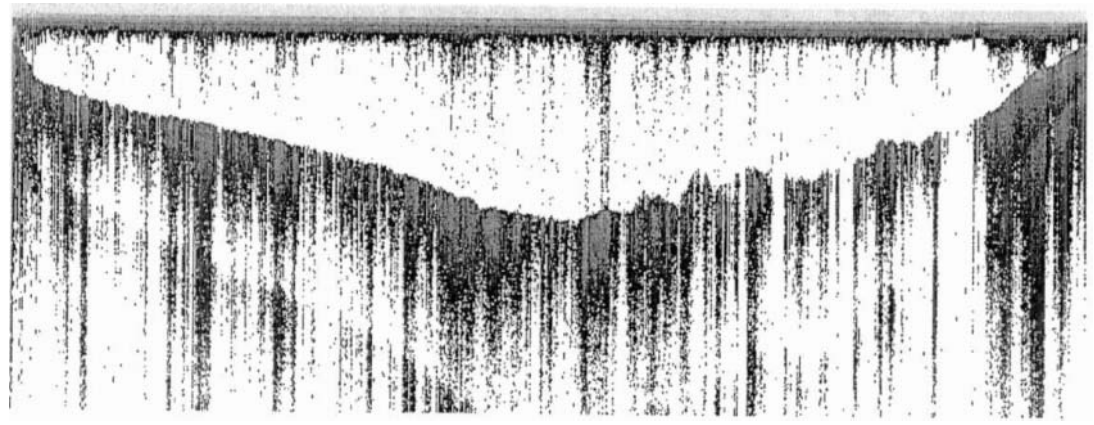

Chart 16: N64°40.385', W140°53.888' just down of 14 and 15. This was off a small gravel point.

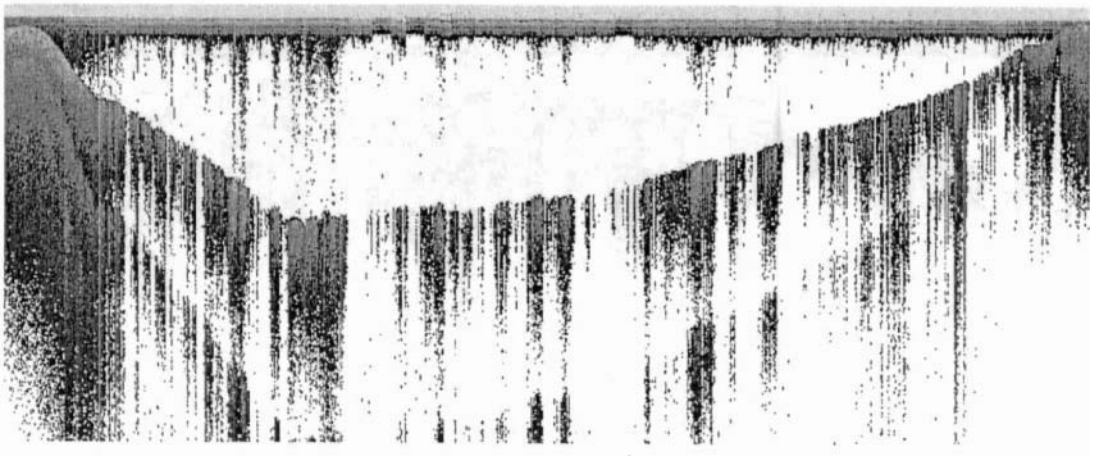

Chart17: The inside channel of island. N64°40.537', W140°54.947'. Narrow little channel (~40 yrds @ 3' of depth))

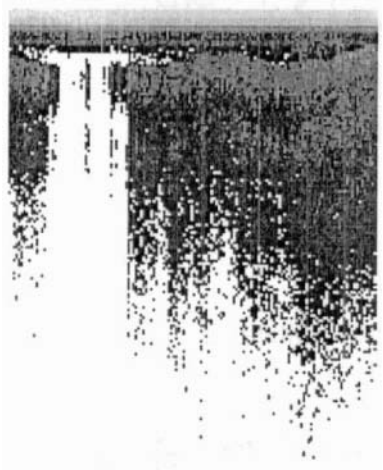

Chart 18: N64°40.866', W140°57.742'. South bank to north bank. At the end of the: file, we turned around, it doesn't go deeper again!

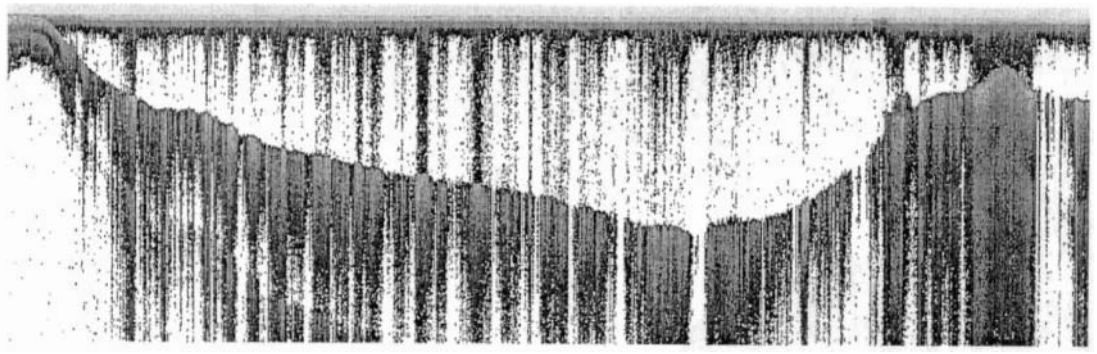

Chart 19: Just down from 18, North to south bank about a mile on the Canadian side.

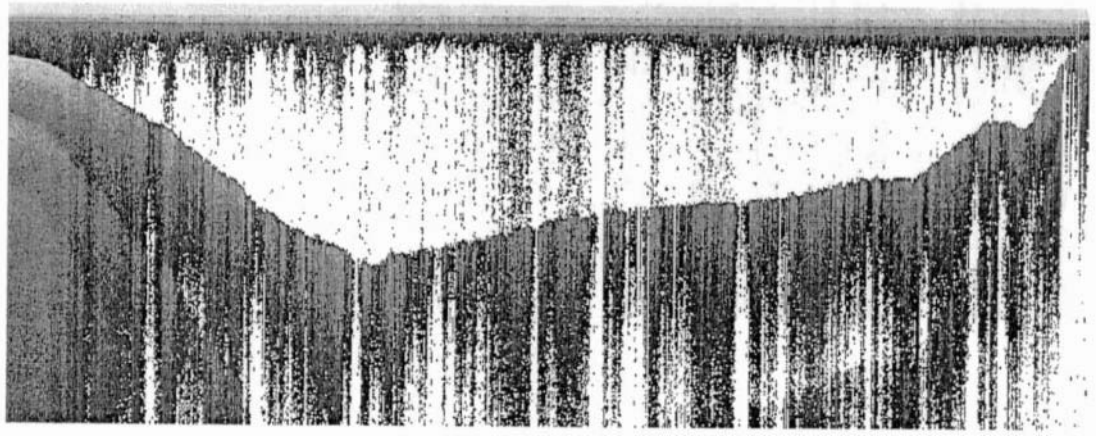

Chart 20: Up above rock point North to south bank. N 64°41.062', W140°57.477'. Good south bank profile

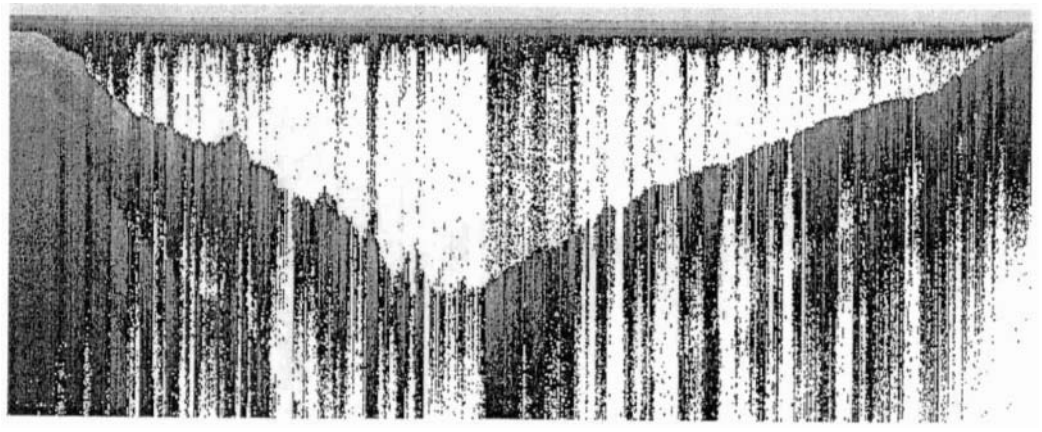

Chart 21: **At** border, south to north bank. N64°40.894', W140°59.996'. Not very good.

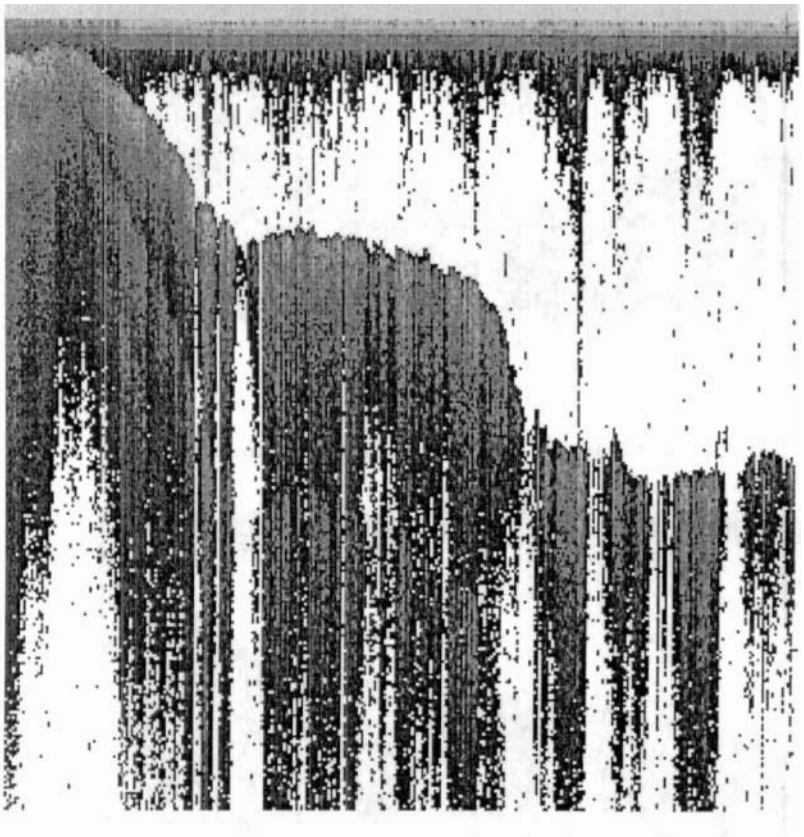

Chart 22: Few hundred yards down from Border. N 64°140.976', W141°00.612'

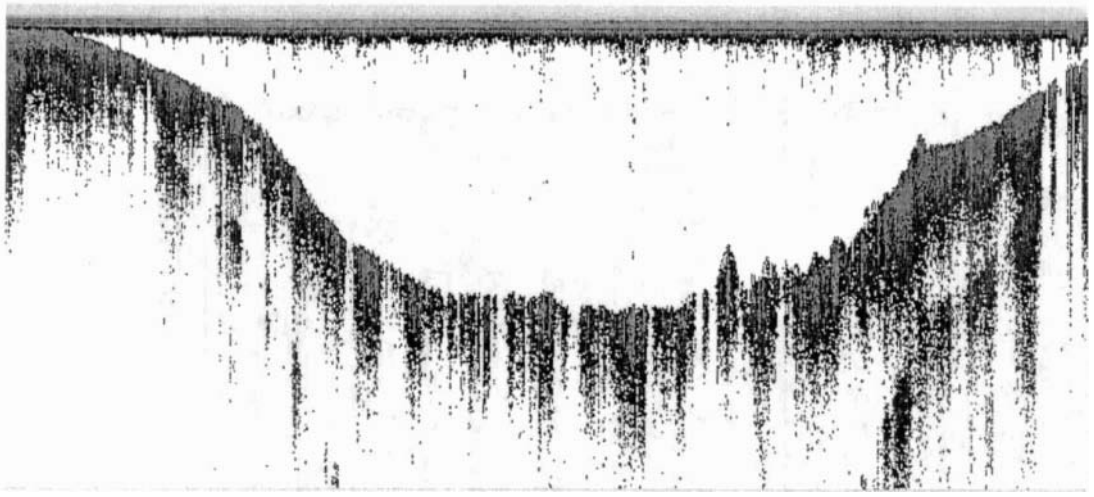

Chart 23: N64°46.541', W141°04.638'. South to north bank, just up of Eagle. The end actually goes straight up to shore. The file was stopped a bit late.

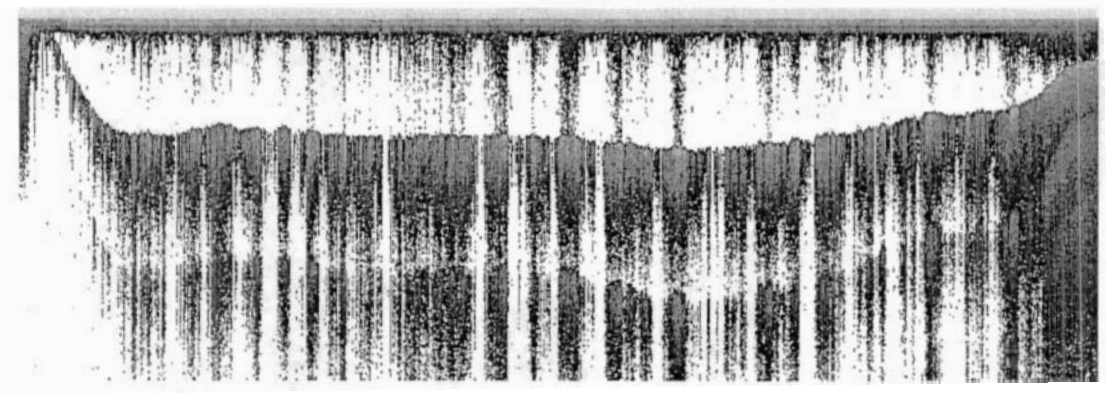

Chart 24: Shade Creek, N64°53.222', W141°07.619'. South to north. Pretty flat on north side.

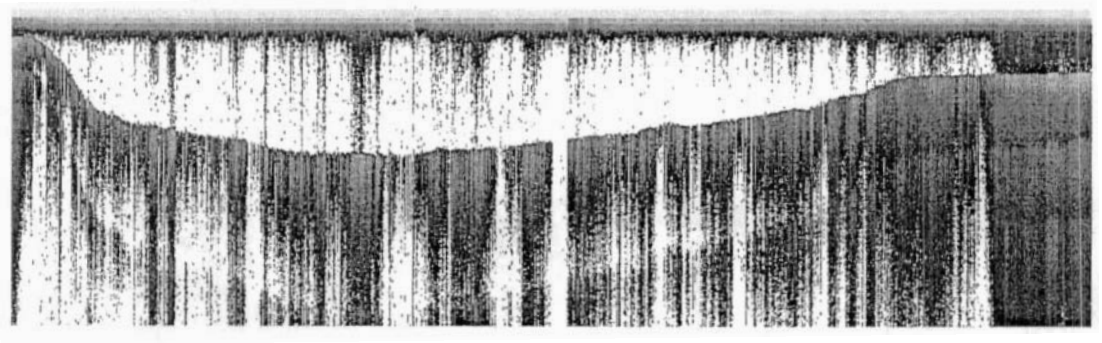

Chart 25: Just up from 24.

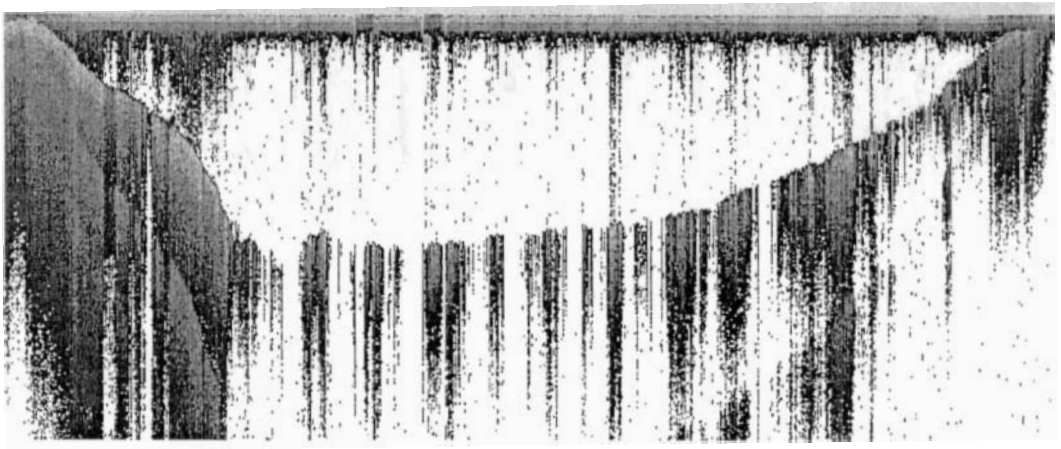

Chart 26: Up from 25. N64°53.165', W141°06.892'. South to north bank. Ended late. Looks like a fairly good profile, at least on the south bank.

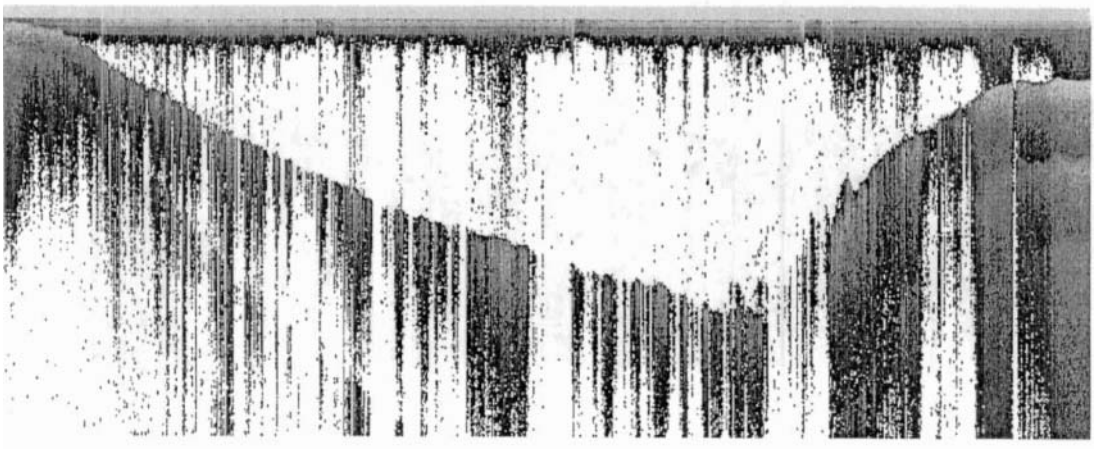

Chart 27 Same as 26 but from North bank to south bank to get a better feel for the North bank. Good chart! Width about 300 yards

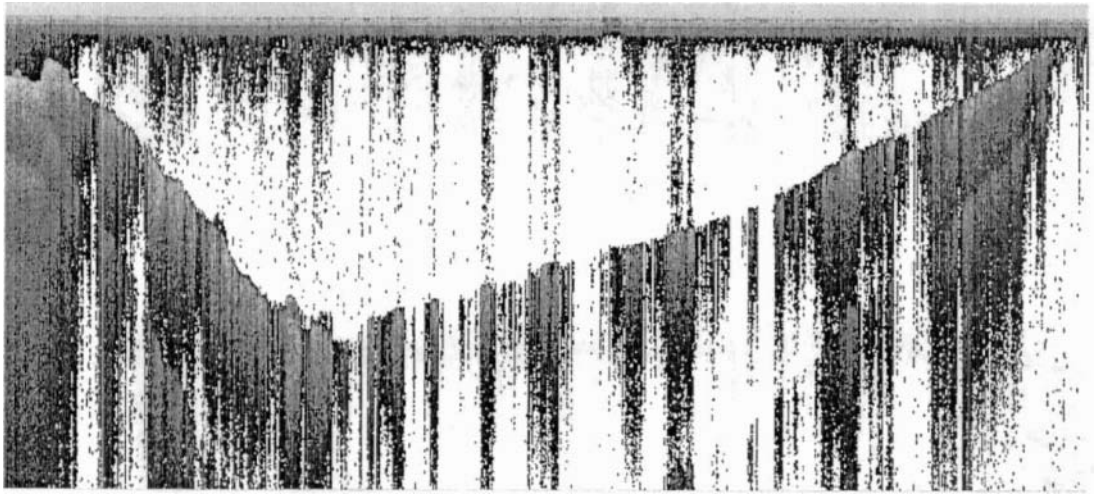

Chart 28: Upstream of 27. N64°53.126', W141°06.602'

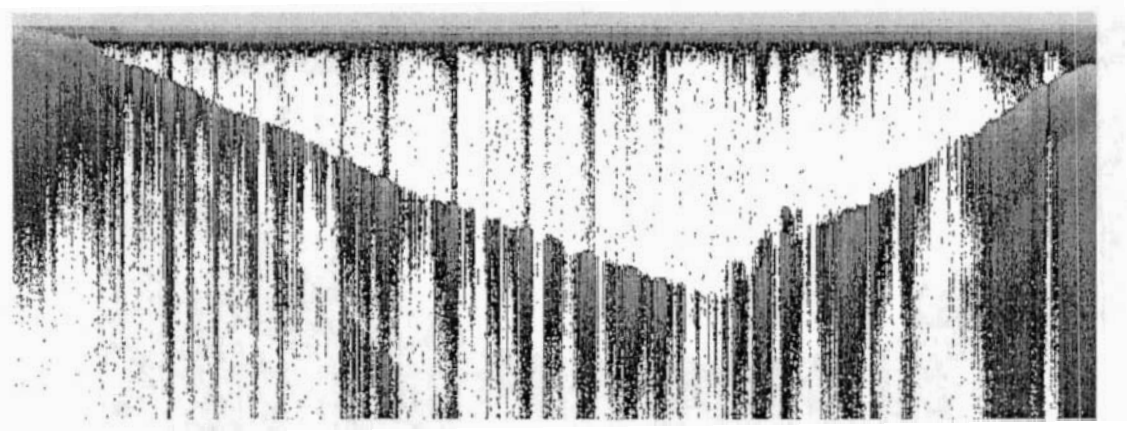

Chart 29: Calico Bluff. N64°54.289', W141°11.560'. East to west bank.

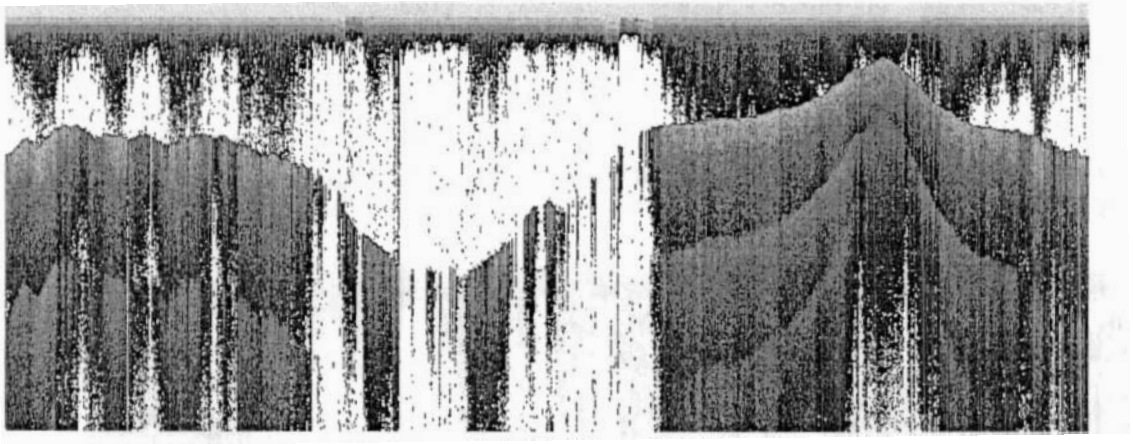

Chart 31: N64°54.742', W141°11.292'. Good chart, went from west to east bank.

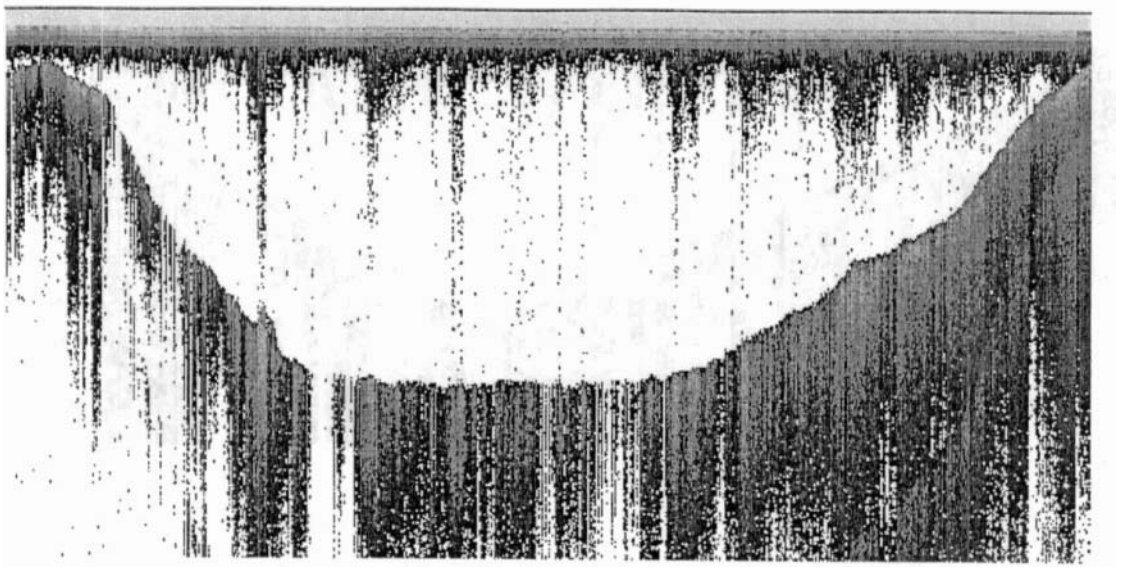

Chart 32: N64°55.870', W141°10.374'. West to east bank. Distance about 350m. Good profile, best so far. A bit of an island to the west but would have to have high water to get enough water to have a channel.